THE ELECTRICAL WORLD

VOL. IV.—No 16. NEW YORK, OCTOBER 18, 1884. $3.00 PER ANNUM. 10 CENTS A COPY.

The Western Electric Company's Multiple Switch-Board.

Nothing illustrates more forcibly the growth of telephony than a comparison of the original four-way switch-board for a telephone exchange, used in 1877, with the latest triumph of the art, the new multiple switch-board. Both of these extremes were exhibited by the Western Electric Co. at the International Electrical Exhibition.

In our issue of October 20th, 1883, we illustrated the then latest board made by the same company, but, because there have been some radical changes made in it for convenience of manipulation, we herein describe and illustrate the new production.

Fig. 1 shows the board, as it appeared at the Exhibition, presently show. They all come in at the back of the board and are bunched back of the framework between the upper panels, and are thence distributed, two to each jack, the two being the incoming wire and the outgoing one which runs to the next board; or, if the last board, to another jack and its appropriate annunciator magnet. Each switch-board would then have to be enlarged, if more wires were to be accommodated.

There are five upper panels, and each panel is made of six boards, which are removable to receive a group of 100 jacks. Four groups of jacks are shown in Fig. 1, replacing a like number of panel boards. This number (400) of jacks implies the use of another board of a capacity of two hundred lines, or four hundred lines in the exchange, all told.

brought to its upper jacks, but only lines numbered from 201 to 400 inclusive will be brought to its lower jacks. This order is continued through all the switch-boards up to the limit.

Each line is carried from the last jack to its appropriate numbered annunciator-drop magnet, and thence to ground. This completes the line circuit, which is normally closed, but for purposes of the exchange various instruments must be intercalated in them at times. These instruments are in each case in an open circuit, of which two plugs are the terminals. After two subscribers have been connected, and while conversing, this intercalated circuit consists of a plug which has been inserted in the calling subscriber's spring-jack in the lower groups of jacks; a flexible conducting-cord looped through a weighted pulley, after the

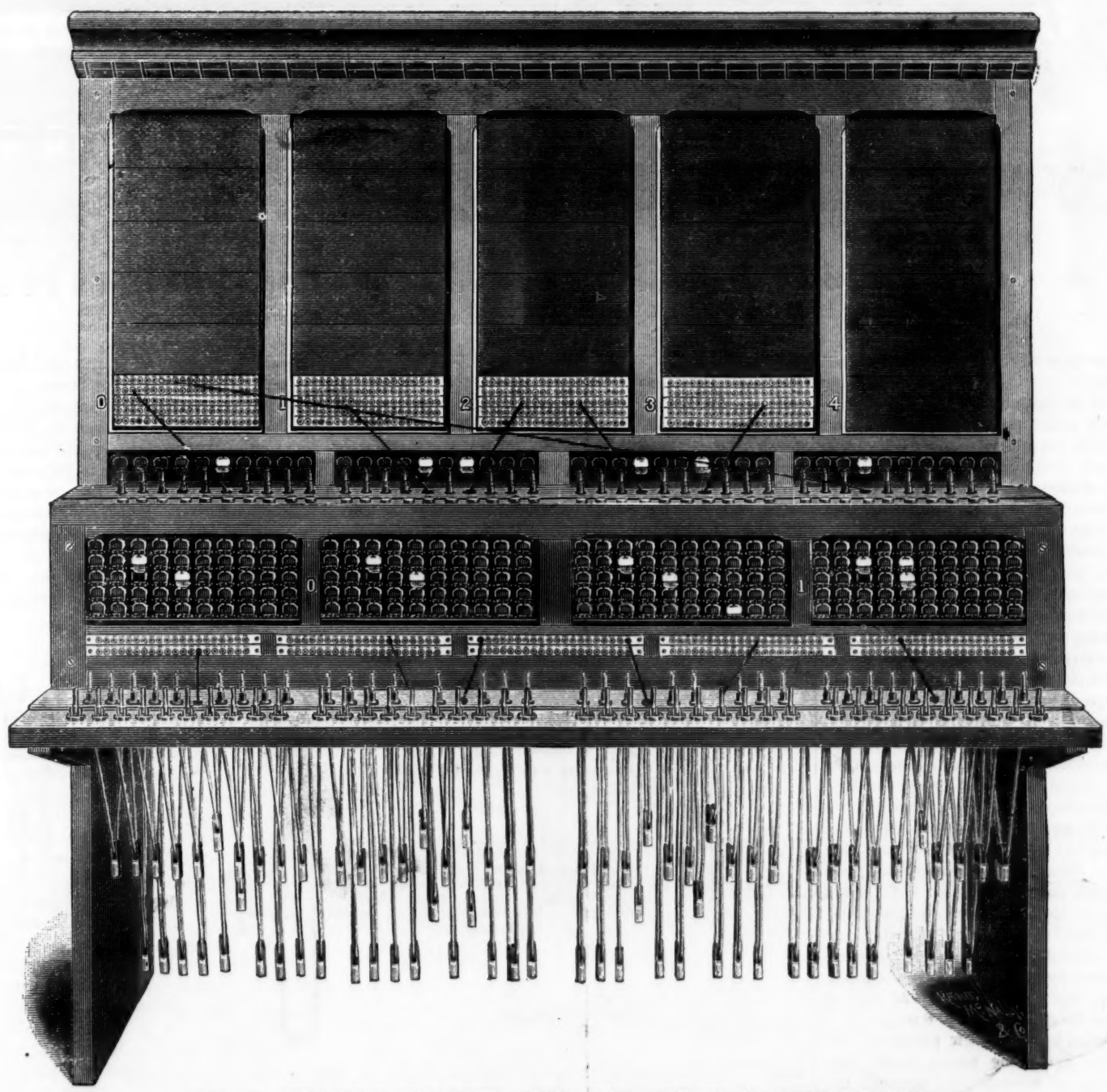

FIG. 1.—WESTERN ELECTRIC CO.'S NEW MULTIPLE SWITCH-BOARD.

equipped for 400 lines. Many telephones were placed in positions around the building, and in the various offices, for the free use of the public. The lines from these telephones ran to this board as a central station, so that telephonic communication was easy between those who desired such accommodation, both within the building and without, throughout the city.

By multiplication of these boards a capacity of 3,000 lines can be gained at a single station. Carrying out the same system even a much larger number of lines might be used, provided slight changes of form of the board be made. But 3,000 exceed the number of lines at present centred at any exchange. The reason why a change of form would be needed is that the full number of exchange lines comes to each board, for the purpose which we will

If exceeding four hundred lines were to be used, another board would be placed in the exchange, and another group of jacks would replace a panel-board in each switch-board; and so on up to the limit of 3,000, or 30 groups of 100 jacks each.

The line entering the exchange is carried to its appropriately numbered spring-jack on the upper panels at the first switch-board, and runs from that to the same numbered spring-jacks of each successive switch-board in serial order, and then to the same numbered jack placed on its appropriate switch-board just above the lower shelf. Thus No. 1 switch-board will have all the lines brought to the jacks on the upper panels, but only the lines numbered from 1 to 200 inclusive will be brought to the 200 lower jacks. Switch-board No. 2 will also have all the lines

manner shown in Fig. 1 underneath the board; and a clearing-out annunciator-drop to designate the fact that the line is disengaged. Another flexible conducting-cord in electric connection with the first cord, and likewise roved through another weighted pulley, and terminating in a plug which is inserted in the called-subscriber's jack, whether No. 9 or No. 2,999 or any other number within the limit of the exchange.

For each one hundred subscribers there are provided twenty of these plug-circuits; this being above the likely extreme limit of ratio of working subscribers lines at any one time.

It is necessary, however, that the operator at the exchange should have her telephone receiver and transmitter within the circuit at times; so there is provided a like

number of listening keys, or levers, located at the front of the lower shelf, by the use of which she may switch the instruments into the circuit at will. The keys are levers which, when standing vertically, show that the operator's telephone is not in circuit; but, when lying horizontally, show that the instruments are in circuit.

At the front of the upper shelf are forty buttons, each of which when pressed throws into the appropriate circuit a generator of alternating currents of electricity for the purpose of actuating the call-bell of one or both of the subscribers on that line. The mode of operating this switch-board is best explained by supposing some calls and appropriate attendance. Take Fig. 1, and consider the first upper group of jacks numbered up to 100, the second up to 200, the third 300 and the fourth 400. Next below is a row of forty clearing-out drops; then, on the upper shelf, a row of 40 plugs, and front of them the row of 40 calling keys, or buttons; below these are the 200 annunciator drops in four groups of 50 each, and numbered from the upper right-hand corner of each group in ordinary succession; below these, the 200 calling subscribers' jacks in five groups of 40 each; and on the lower shelf a row of 40 plugs, with a row of 40 listening keys in front of them. Let us suppose that subscriber No. 34 has called. This will be denoted by the fall of annunciater drop No. 34. The operator then takes the nearest unoccupied plug, No. 6, on the lower shelf and inserts it in opening the jack No. 34, as is shown by the dark line representing the cord. She then pulls forward the lever to the listening key belonging to that plug and cord and calls through the transmitter. Suppose that subscriber No. 23 is wanted: she then takes No. 6 plug on the upper shelf and inserts it in entrance to jack No. 23, which is in the first panel, as is shown by the black line representing the flexible cord. She then presses No. 6 calling key or button on the upper shelf, to ring up subscriber No. 23. As soon as communication is established between Nos. 34 and 23 she throws back the listening key or lever, so that her telephone and receiver may be ready for another call. Now if the subscribers are good subscribers, such as obey the rules, they will, when through conversing, hang up their receivers and ring their call bells to signify that they are satisfied. In such a case the electric current sent through the line will cause clearing out drop No. 6 to expose that number and thus call the operator's attention to the fact that the lines of 23 and 34 are disengaged. She then removes both No. 6 plugs from the jacks and they are pulled back to their places by the weighted pulleys. In the figure the heavy black lines show, somewhat, the range of connections through the plugs and flexible cords.

There is a provision made for such cases as those in which lines not under the control of the operator at one switch-board may be tested, to determine whether occupied or not, by each operator independently of the others. We will speak of this later on.

Fig. 2 represents a single one of the spring-jacks. The incoming and outgoing conductors are insulated from each other except at the contact points between the curved spring and the side-bolt. When the plug is inserted the spring is thereby lifted from the bolt, or contact point, upon which it normally rests, and thus disconnects the annunciator and ground, to establish connection between the line and the cord through the plug, as well as establishing a cross connection between the line and the frame of the jack. As the frames of all the jacks of the same number are connected together, they are consequently all crossed with the line.

FIG. 2.

The jacks are mounted, to the number of twenty, in strips of insulating material, after the manner shown by the three views of Fig. 3. These strips are then associated in groups of 100, as shown in Fig. 1.

The connections between the spring-jacks of the same number on three switch-boards are shown by the diagram Fig. 4. *A* is the line and *B* the conductor which serves to connect the frames of the jacks together. A plug is shown in No. 2.

Whenever an operator desires to know whether any line is engaged through any other board, she touches a plug to the jack of the same number as the line, and, if the line be engaged, there will be an audible click in the operator's receiver due to the short circuit so made through the receiver. She may then state to the calling subscriber that the line wanted is engaged, all without the former delay and trouble incident to other systems in large exchanges.

At the Exhibition the calling generator was a magneto constantly running by the movements of an electric motor. Of course other devices giving alternating currents can be used for the same purpose.

This switch-board attracted much attention at the Exhibition. It is a handsome piece of mechanism, as well as most complete in satisfying the working requirements of a large telephone exchange, with the minimum number of attendants, and reflects much credit on the manufacturers. One operator can serve with this switch-board two hundred subscribers. The instrument is protected by a number of patents granted to Messrs. L. B. Firman, C. C. Haskins, C. H. Wilson and C. E. Scribner.

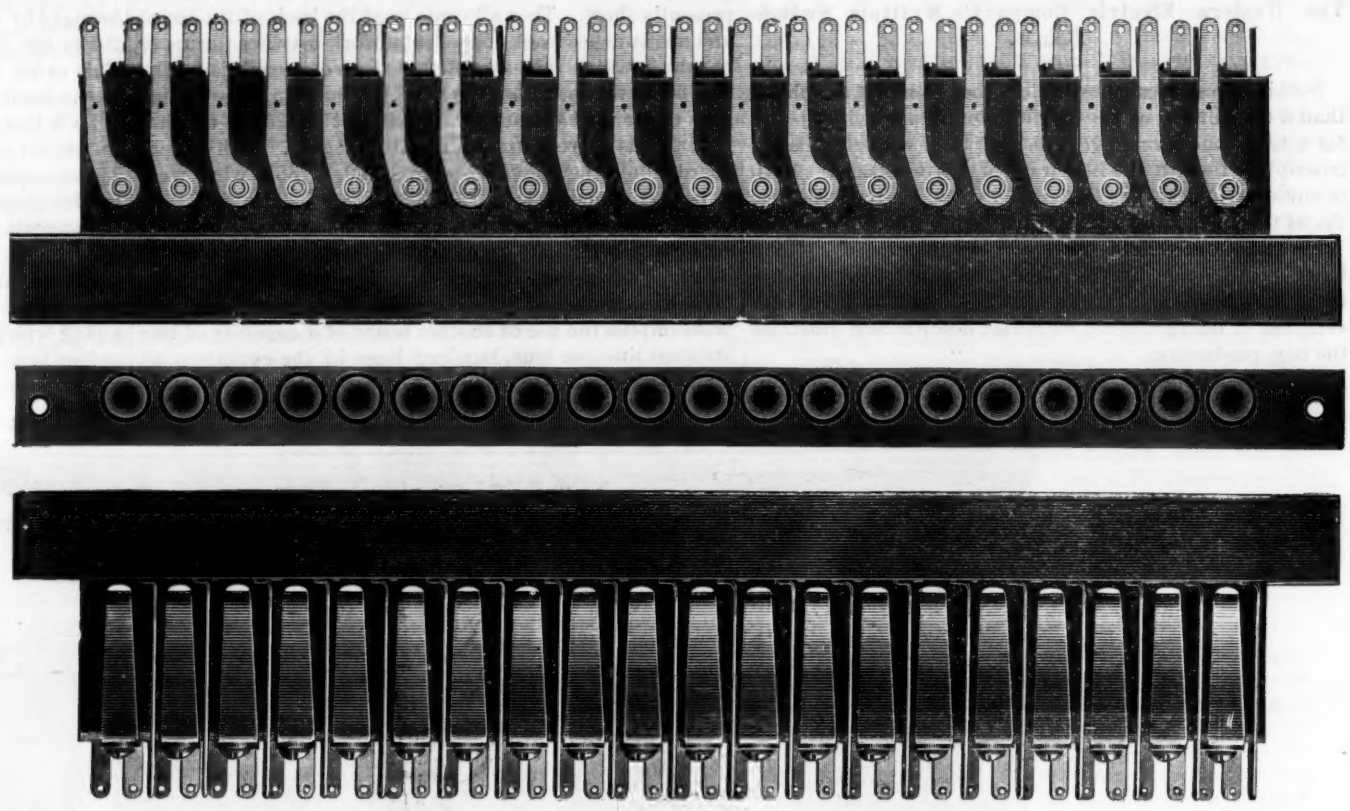

FIG. 3.

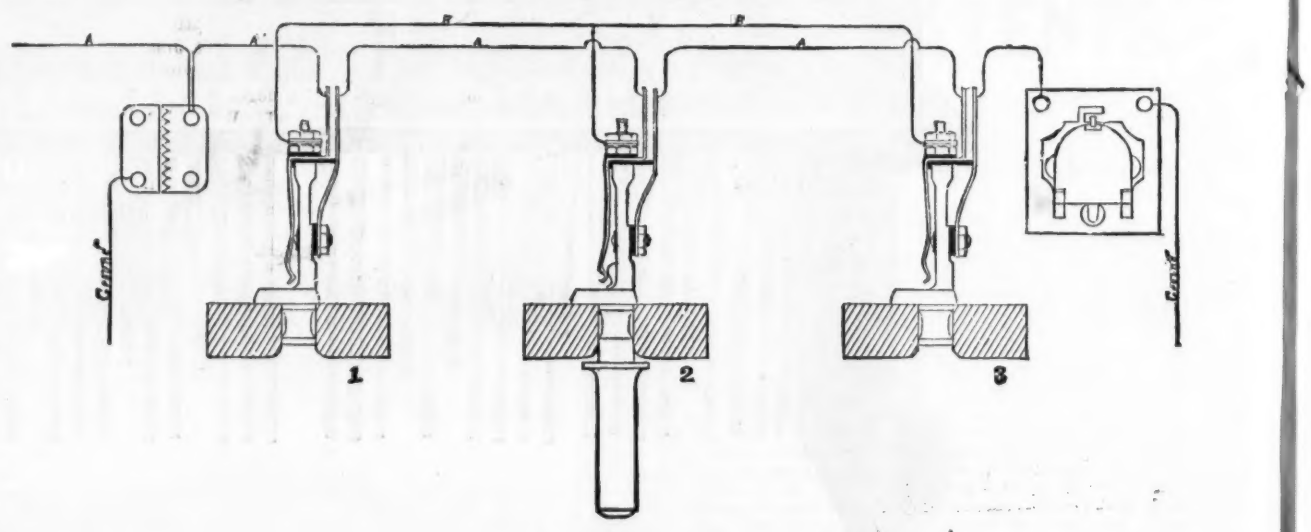

FIG. 4.

The Telephone in Europe.

We publish in this issue an editorial on the telephone in Europe, and give additional figures below. The use of the telephone is generally on the increase in most parts of the Continent, the subscription in France being at the rate of 200f. ($40) per annum, reduced to 170f. when there are over 300 subscribers. The manufacturing towns of Lille, Roubaix and Turcoing are now in communication, the average number of messages per day between the two latter places being 657; and the system is in force also at St. Quentin and Troyes. Rheims is the best served town in France for its size, and contains 210 subscribers, or 23 out of every 10,000 inhabitants. This is the highest number comparatively in the whole country, Paris, Lyons and Bordeaux having but 14 to every 10,000; Calais and St. Pierre, 22; Havre, 18. The total number of French telephone subscribers is 5,535, while Germany has only 4,000 in 21 cities and towns. The proportion at Berlin is nine to the 10,000 inhabitants, Vienna four, and Brussels 11. Munich has 393 subscribers, Leipsic 285, and Chemnitz 101. A system has just been inaugurated at Mons, in Belgium, so that the inhabitants of the Borinage coal district may converse with Brussels, Antwerp, Charleroi, Liége and Verviers.

Since obtaining a prolongation of its concession for five years the Société Générale des Téléphone has been studying several important improvements demanded in France by the subscribers, who will ere long be put in communication with the telegraph system, so as to receive and transmit their messages direct. In conjunction with the company, the Minister of Posts and Telegraphs is arranging for a number of public telephone offices to be started in connection with the system. The *Bulletin de la Compagnie Internationale des Téléphones*, says that a number of business men who are in frequent relations with notaries contemplate boycotting, or at any rate sending to Coventry (*mettre en interdit*), those members of the cloth who do not place themselves in telephonic communication.

An experimental illustration of telephonic communication between distant towns was performed in England last month by the United Telephone Company. A numerous party was invited to witness the transmission of messages between Dover and London, along the telegraph wires of the London, Chatham and Dover Railway, permitted by the chairman of that company, Mr. Forbes. The first experiments consisted of messages transmitted from the Grosvenor Hotel to Dover along a single wire brought to earth at both ends, and having in its route no less than nine block signal stations, the single needle instruments in which, and the other apparatus, being equal to over nine miles per station. These constituted a resistance of nearly 100 miles beyond that of the line wire, which was 78 miles long. The second experiment was the transmission of messages along a metallic circuit, making 156 miles of wire, to which the block instruments added 200 miles resistance, making the total traversed by the messages the equivalent of 356 miles. Nevertheless, the words were clearly and distinctly heard, so much so that one listening in the Grosvenor could instantly detect the errors

of the operator in misquoted words in the nursery rhymes which he narrated for the edification of his London audience. The chairman of the company, Mr. Brand, Mr. J. S. Forbes and others were present, and general satisfaction was expressed.

The Brush Hand Arc-Lamp.

It has not been found practical to use automatic regulators of the arc in the projectors used in search-lights. The automatic regulators do not preserve a constant position for the arc at the focus of the reflector. They are based upon a stated difference in the rates of combustion of the positive and negative carbons. This difference is approximately the ratio of 2 to 1. That is, the positive carbon burns away twice as fast as the negative. But this is not absolutely the true ratio, even with two carbons of exactly like composition. The ratio also varies with carbons of unlike consistency, etc.

Therefore, in cases where it is of prime importance to keep the arc at the focal point, hand-regulators must be used under the constant supervision and manipulation of the operator. Of course it is expedient to have such instruments as convenient for handling as possible.

Such ease of handling seems to be secured for the Brush Electric Co.'s "Hand Lamp," illustrated herewith. The upper carbon is made the negative and is clamped to the arm, which is adjustable in position and is fastened by the clamp screws operated by the key shown in one of them. The lower carbon is fastened to a tubular carrier which slides over a pedestal. On the outer surface of the tubular carrier a contact spring presses for the purpose of conveying the current. This carrier is insulated at the disc on one of its arms, but its extension from which it is insulated slides vertically on the square rod upon which the arm of the negative carbon also slides in approach or recedence from the arm of the lower carbon carrier.

The feed movement of the carbons is effected by rotating the threaded rod shown at the back of the square rod. The screw threads are respectively right and left handed, so that a rotary movement of the threaded rod in either direction causes a simultaneous movement, to or fro, of the two carbon-carriers. The hand-wheel is for the simultaneous raising or lowering of the two carbons together, while the T wrench is for effecting the necessary feed movements after the arc has been put at the focus of the projector. Beveled gear-wheels communicate the motion from the wrench.

It will be noticed that the two carbons are of unlike size, and that the threads on the threaded rods are of unlike pitch. These two conditions are for the purpose of avoiding as much as possible movements of the two carbons in one direction or the other, vertically, to bring the arc at focus. The instrument is well constructed and is efficient in operation with the minimum of care and manipulation.

THE BRUSH HAND ARC-LAMP.

Closing the Exhibition.

We are indebted to the Philadelphia *Times* of Oct. 12, for the following report of the closing scenes at the Exhibition. The figures are those furnished as a fair estimate by the Franklin Institute:

The Electrical Exhibition closed last night. At half-past eleven the fountain stopped playing, Edison's cone flashed its two thousand incandescent gems for the last time, and the lights all over the building went out. The enterprise has been very successful from every point of view, and the exhibitors express themselves generally as being fully satisfied with the results as far as they are affected by them.

The public is shown to have appreciated the exhibition by the numbers who have visited it. The estimated total of visitors is 300,000. Of these during the last week the daily attendance averaged 14,000, the largest attendance on any day being on Thursday, when the turnstiles registered 16,624. The smallest attendance was during the intensely hot weather, on Sept. 5, when only 2,658 people passed through the gate. The management state that all expenses have been fully covered and a surplus remains. In round numbers the receipts amount to $100,000, of which $90,000 has been paid away in general expenses, leaving $10,000 profit.

The managers intend keeping the building standing for five years, giving some exhibitions each fall. One good thing accruing to the Franklin Institute through the exhibition is the valuable collection of electrical literature entitled the Historical Library. This has all been catalogued and arranged by Emmanuel Hiltebrandt, librarian of the Institute, and numbers over two thousand titles. The collection is valued at many thousands of dollars, for a large number of the works are unique, many are out of print or otherwise unobtainable, and the entire library is probably the most complete collection of works on the subject of electricity in the world. Besides these books, Professor Van der Weyde has presented to the Institute his collection of telephonic apparatus, which includes some eight or ten musical and speaking telephones and other apparatus.

An average has been estimated of the total cost of the exhibition to exhibitors. It is said that about $300,000 will cover everything.

It was somewhat late to begin an experiment on the closing day of the exhibition, but the trial trip of W. W. Griscom's electric railway was so thoroughly successful yesterday as to make up completely for the deficiency in punctuality. Mr. Griscom is the presiding inventive genius of the Electro-dynamic Company of Philadelphia. This company has had several small dynamos and motors on exhibition, and was anxious that Mr. Griscom should perfect his electric railway in time for the exhibition. He has been delayed by a variety of causes, but yesterday morning got his car in place on the triple track which has been laid on Thirty-second street from Lancaster to Powelton avenue for over a week. The operations have been watched by large crowds with much curiosity.

In the car, an old one belonging to the People's Railway, were seated President William P. Tatham, of the Franklin Institute; Professor Houston, Mr. Edgar, electrician in charge of the Edison exhibit, and others. Mr. Griscom turned on the current, and away went the car up a grade of two hundred feet to the mile at the rate of eight miles an hour. When it returned the speed increased to twenty miles. The car was under complete control, the brakes acting almost instantaneously.

The current of electricity is produced from one of Weston's eight horse-power dynamos, and is conveyed to the middle rail—an ordinary steel rail—of the track. It is taken up from this by a copper brush and passed to the motor, which is supplied by a series of eight variations of resistance for regulating the speed. The current then passes out through the other rails and back to the dynamo. In case of running these cars in the city only two rails would be used, and the current generated by the one dynamo is strong enough to serve cars anywhere within twenty miles of the central station.

Landing the Commercial Cable near New York.

About 500 ladies and gentlemen assembled at Manhattan Beach, Coney Island, on the 16th inst., to witness the landing of the shore end of the second Commercial Cable from the "Faraday." It was found impossible to bring the end ashore then, and the ceremony was therefore postponed until yesterday, the 17th. A very fine luncheon was given, however, by the company at the Manhattan Beach Hotel on Thursday, and it was heartily enjoyed by all present. Among the gentlemen present at the luncheon were Mr. George G. Ward, the general manager of the Commercial Cable Company; Mr. David B. Davidson, the representative of Mr. J. W. Mackay; Messrs. Henry Rosener and Geo. S. Coe, directors of the Cable Company; Mr. Hoeltze, engineer for laying the underground cable; Indian Commissioner W. H. Lyon, one of the pioneer electricians; Mr. W. I. Graham; Mr. Edward Chester Smith, the company's architect; Mr. George W. Jones, electrician of the Banker's & Merchants' Telegraph Company; Mr. John Muirhead, the inventor of duplex ocean telegraphing; Mr. F. W. Cushing; Mr. George S. Hart, of the Postal Telegraph Company; Mr. J. E. Coleman, Mr. Oscar D. Mott, the Rev. Noah Hunt Schenck, Hector de Castro, a representative of THE ELECTRICAL WORLD, and many well known electricians, capitalists and professional gentlemen.

The prosperity of the Commercial Cable Company having been proposed, and the health of Manager Ward drunk in bumpers of champagne, Mr. Ward was prevailed upon to make a little speech. In the course of his remarks he said:

"In 1866 it was thought a great thing to have an Atlantic cable landed 2,000 miles away from New York, and in 1858, when Mr. Cyrus Field organized the first Atlantic cable company, I imagine that he could hardly have supposed that a cable connecting the Old World and the New would ever be brought directly into our great metropolis. I don't know of any similar city in the world which will enjoy the great advantages which New York will have when that cable is landed. The value of this connection cannot be overestimated, as it gives us direct cable communication, from our very doors, with the heart of Europe. I will undertake to say that a question can be asked from New York to London and an answer received here inside of three minutes.

"It is not for me to speak of the enterprise of the two gentlemen who are the originators of the great undertaking. I think that speaks for itself. I will simply state that the total number of miles of cable that comprises this system is 6,500, and this great ship, with its able owners and officials, have done the work since March last—a piece of work that has never been equaled before.

"With two cables duplexed by Muirhead's method, giving a carrying capacity of four single cables, with its branch cable to Havre, with its repairing steamer, which has just been launched, and with its own offices in London, Paris, Liverpool, Glasgow, Manchester and Havre, connected by special wires, I have no hesitation in saying the Commercial Cable Company will have the most complete Atlantic cable system ever established, and with a liberal support—which I am sure the public will give it—the company feels confident of its ability to maintain a vigorous and lasting opposition to monopoly."

Speeches were also made by Mr. Muirhead, who explained the duplex system of telegraphing, and by Mr. W. H. Lyon.

After luncheon the company repaired again to the beach and remained until information was received from the "Faraday" that the arrangements for sending the cable ashore would not be fully completed before dark, and that it would be better to defer making the shore connection until Friday morning.

American Electrical Exhibition.

The officers of the American Electrical Exhibition, to be held at Boston from November 23 to January 3, have been very active lately in getting together not only a large number of electric light exhibits but of novelties in all branches of the electric science, in order to outdo, if possible, the late Philadelphia "Show." They have the advantage of an elegant and spacious building, located in the city and near several railway stations, and have the good will of the city authorities and the New England people generally, the Mayor of Boston being at the head of the Advisory Board. Many of the electric light people who have exhibited at Philadelphia will embrace the opportunity to show the advantages of their respective systems to the people of New England, who, perhaps, are most interested in the practical application of electric lighting for illuminating large buildings, such as mills or manufactories. Telephony and telegraphy may be said to have their homes at Boston, and will, perhaps, make the best showing there ever made anywhere, while the numerous emanations of the fertile Yankee mind will doubtless add to the attractions of the general exhibition.

The Boston public is especially interested in electric appliances. Almost everybody there has money invested in some electrical scheme—a fact which will insure a large attendance and an eager examination of all matters displayed. The management is said to be in good hands, men experienced in exhibition business only being employed for the various departments. Preparations are already in a forward state.

THE ELECTRICAL WORLD

PUBLISHED WEEKLY,

AT NO. 9 MURRAY STREET, NEW YORK.

W. J. JOHNSTON, Editor and Publisher.
N. S. KEITH, Associate Editor, Scientific Department
T. C. MARTIN, " " News Department.
CLARENCE E. STUMP, Business Manager.

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THE ELECTRICAL WORLD,
New York.

NEW YORK, OCT. 18, 1884.

EUROPEAN TELEPHONE STATISTICS.

We published last week a humorous description from a California paper of the manner in which a raw farmer from the interior of the State endeavored to handle a telephone at Sacramento; and we remarked then that to a great many people in this country, the telephone is an unknown instrument. They have never seen it, or never handled, and have not the remotest idea of its construction and operation. But if this be the case in the United States, with its one thousand telephone exchanges and far-reaching extra territorial lines, still more is it the case in Europe. Some interesting statistics have recently been made public in regard to the use of the telephone in the leading cities of Europe, and the showing is most meagre. In London, it appears, the number of subscribers to the 30th April, 1884, was only 3,350, or less than New York, although this city has but about one-fourth the population that London has. The great centres of Liverpool, Manchester, Southport and Blackburn, at the 30th June, had only 2,734 subscribers. In fact, Great Britain, with a population above thirty millions, has barely 12,000 telephone subscribers. In France, the cities and towns of Paris, Algiers, Bordeaux, Havre, Lille, Lyons, Marseilles, Nantes, Oran, Rouen, and St. Pierre-le-Calais, have only 5,535 subscribers all told. In Belgium, the cities of Brussels, Antwerp, Charleroi, Ghent and Verviers muster 2,234 subscribers. In Italy, the cities and towns of Milan, Florence, Bologna, Leghorn, Venice, Rome, Naples, Palermo, Messina and Catania have only 4,249 subscribers, and if we allow roughly 1,000 more for Turin and Genoa, the number only mounts up to about 5,000.

These figures show the low standing of the telephone in some of the largest centres of population in Europe, as a means of communication. To them may be added the figures given by us for Germany last May—only 6,182 for the whole empire, and almost exclusively in cities and large towns. In Spain, we find small municipal services at Bilbao and Valencia, and military systems at Valencia, Saragossa, Carthagena and Madrid; but practically no commercial service at all. In Turkey, there is no public telephone service, and the total of telephone wire in use is only forty-one kilometres. In Servia, there is only one short official line, while Bulgaria and Luxembourg have merely a kind of vague knowledge that there is some sort of instrument called a telephone in existence somewhere. It is true that the northern countries of Europe use the telephone, but the figures of Sweden, Norway and Denmark are insignificant. Russia shows more appreciation, and a St. Petersburg correspondent, whose letter we publish to-day, says that Moscow has 450 subscribers.

These figures are not complete, as many cities in Europe have not been included, but they serve to illustrate in a most striking way the backwardness of Europe telephonically, as compared with this country. If this be the extent of the patronage of the towns and cities, it is easy to understand that there are millions of well-to-do people in Europe who are still unable to get the telephone, and that the service there is in its infancy—even in the embryonic stage. Gen. Thomas Sherwin, the auditor of the American Bell Company, in his statistics brought down to January, 1884, divided the telephone exchanges in this country into four schedules: The first in cities and towns over 150,000 inhabitants; the second, from 50,000 to 150,000; the third, from 10,000 to 50,000; the fourth, 10,000 and under. It appeared that in the third schedule there were 211 exchanges, with 47,207 subscribers, and in the fourth no fewer than 658 exchanges, with 31,000 subscribers. These last two schedules could not be made up at all in Europe, as there is no material for them, the telephone service throughout Europe, as a rule, stopping short at the 50,000 line of population.

Still, there is hope, and the field may be said to be white unto harvest. The figures from all parts of Europe exhibit a steady increase. London gained 25 per cent. in the last year, and Liverpool and Manchester 17 per cent. France is gaining ground at the rate of 15 per cent. per annum, Belgium 9 per cent. and Italy 30 per cont. Italy has enjoyed a more liberal governmental policy than some of the other European countries, and this will explain the high rate of growth there. But we may now look for a grand development in England under the new régime.

PRINTING BY ELECTRICITY.

Our readers know that we have already stated fully the facts connected with the exhibit of The Electrical World at the Philadelphia Electrical Exhibition, and all who attended the Exhibition are aware that every word we have printed has been strictly within the bounds of truth. The Ilion *Citizen* accused us of claiming publicly that this journal was the first in the world to be printed by electricity, a charge that we have shown to be utterly false and absurd. The *Citizen* has not had the courage to expose itself by reproducing our defense, but in its reply descends to low abuse, expressing its delight at worsting "inflated city gods," and boasting that we have "the wrong pig" by the ear. We shall not stop to inquire how thoroughly the editor of the *Citizen* has characterized himself in this remarkable utterance, but will go on to show the dishonesty of his assertions and attacks.

Afraid to reprint our editorial of Oct. 4, the editor of the *Citizen* now bases his insults on new grounds. He admits that the charges were based on hearsay evidence. He says that he did not see any placards announcing that The Electrical World was the first paper to be printed by electricity,—of course not; there were none,—but that he can get affidavits to the effect that the representatives or supposed representatives of this paper at Philadelphia said so, and that *only* means *first!* This is the extreme of impudence and falsity, and of ignorance too. Until the affidavits are produced, we shall simply say that not one of the six persons connected with our exhibit ever made any such statement, and that that affirmation can be backed if necessary. Moreover, we are in receipt of a letter from Mr. George M. Lee, the electrician to whom the editor of the *Citizen* was indebted for the idea of running his press by electricity when his engine broke down, and that gentleman says: "He should not have attacked your valuable paper in the way he did, and, my dear sir, I will do all in my power to vindicate the rights of the World. I assure you that while at the exposition I called on your agent and was very cordially received, and saw nothing that would show that you were 'borrowing thunder.'" Now it is evident that we could not know when Mr. Lee would visit our exhibit; and as no one in this office had ever met him, he would with the utmost ease have detected a fraud and caught our "agent" tripping if we had been trying to deceive the public. To Mr. Lee belongs the credit of the printing of the *Citizen* by electricity last March, and for the editor of that paper to claim it is the same as if a man, whose broken leg had been skillfully repaired by a new process in surgery, should claim the laurels of the doctor, who, knowing of a successful use of the process elsewhere, applies it to his case.

One other point in these miserable accusations, made against us in order that the false claim of the *Citizen* to be the first paper in the world printed by electricity may be bolstered up, needs refutation briefly. The *Citizen* now says that, in our article on the exhibit and in our circulars, we quoted a press notice that spoke of "the first paper printed by electromotive force," and that therefore, by insinuation, we meant our readers to infer from that notice that our paper was the first in the world to be thus printed. This charge is as hollow, ridiculous and untrue as all the rest. We quoted a number of kind press notices, and it is true the phrase occurred in one of them. We do not think, however, that the writer of it intended to say the first in the world. He had already spoken more than once of our exhibit, mentioning in advance what we were going to do, and when the press began running it was natural that he should speak of the "first," in connection with the opening of the Exhibition. The word "first" was used half a dozen times in every article at the beginning of the Exhibition without meaning more than "first" in a restricted sense, as applied to the commencement of operations by the various exhibitors. But even if the reporter meant "first in the world" we disdained to put any such interpretation on it, for, at the same time, only a few lines below, we quoted a notice from the Chicago *Times*, speaking of the World as the *second* paper printed by electricity. We could not want stronger evidence of our good faith than that; nor a more cogent proof of the brazen impudence of the *Citizen*, than that it should pick out the one notice and say nothing of the other, although they were printed, close together, in the same paper and on the same sheet of circular. We were not responsible for the press notices given to us voluntarily by hundreds of papers, and when we reprinted some of them we did so in a proper way, word for word, without putting a strained construction on them.

This controversy occupies too much of our space; but in vindicating ourselves we have done the science and application of electricity a service, in stripping the *Citizen* of the honors it would usurp and in exposing the mendacity of the statement it still makes in its own behalf. It was not the first paper in the world to be printed by electricity; it was not the first daily paper to print regular editions by electricity; nor was it the first paper to print weekly editions by electricity.

EXHIBITION PROFITS.

As we anticipated last week, the Electrical Exhibition has yielded a handsome profit to the Franklin Institute. It is unusual for exhibitions to have this satisfactory result, and the Vienna electrical exhibition came out badly on the debit side. From the estimates we have quoted elsewhere, it will be seen that the efforts of the Institute are attended by a most gratifying success. The net cash cleared will be about $10,000. That is probably the least item of balance, as the managers have a fine exhibition building, which it is said they propose to use for five years to come, giving exhibitions every fall. Then the Institute has come into possession of one of the most valuable electrical libraries to be found anywhere, numbering two thousand titles, and worth thousands of dollars. Outside this, the Institute has been presented with several exhibits, the money value of which must be considerable.

We are glad to think that the Franklin Institute, venturing much, as it did boldly, has succeeded so well financially. The officers of the Institute we believe are most pleased at the knowledge that they have given a great stimulus to electrical science and application, and earned the warm goodwill of the electricians of America.

SECONDARY BATTERIES.

The interest felt in secondary batteries, in spite of failures and disappointments and partial success, is exemplified in the discussion on the subject at the National Conference of Electricians, as printed to-day in our columns. The literature of the storage question is very slim, and the report given by us this week and to be finished next week, is in reality an important addition to what has been previously published. We recommend the discussion for close and careful perusal.

The Telephone in Moscow.

From St. Petersburg, Russia, Mr. John Crawford, Chief Engineer of the International Bell Telephone Company there, writes us the subjoined account of operations in Moscow:

"Perhaps it may interest some of your readers to know that we moved our entire office in Moscow to another building about 500 feet away, in twenty days. We had some difficulty with the new overseer of the house in which our office was, and he, being an old telegraph man, thought we would never be able to move our office, so he put the screws on. After considerable time lost in trying to arrange matters with him, I was sent to Moscow to remove the system. We had 450 subscribers connected, each on a separate wire, divided into seven routes. I arrived in Moscow on Aug. 8, when we commenced work in the new office by tearing down a partition wall and laying a piece of new flooring. On the evening of Aug. 28, the last subscriber was connected with the new office. All was done without giving the subscribers trouble, and hardly any of them know yet that we have moved. The telegraph authorities are paralyzed at the success of the moving and are unable to understand it. About the sickest man in Moscow is that new overseer, who, reckoning on his own experience in the telegraph business, was certain that we were fast bound, and that, if we moved, it would take at least six months. He has lost good tenants, who would have occupied his building for 20 years. When he has any business with Yankees again, he will have had his present experience to guide him.

The Portrush Railway, Ireland.—A very fine model of the car used on the Portrush electric railway, Ireland, can now be inspected at the office of The Electrical World. This road has been working regularly for several months, and pays a good annual dividend. We shall be glad to have any one interested in electric locomotion examine the car.

National Conference of Electricians.

FIFTH DAY, SEPT. 12, 1884.

The conference met at 10 A. M.

The President: Before commencing this discussion I would like to say a few words. I think we saw yesterday the relative value of theoretical and applied science as applied to the subject of the dynamo machine. We did not find, either, that theory was of no value except as it was applied to the machine or except as it agreed with applied science, but we did find that the two ought to agree with each other. Now, in all these cases the laws of electricity are perfectly well known. We know the laws of magnetization of iron, indeed in none of the applications which we have recently had of electricity have any new laws in regard to electricity been discovered. They are simply the application of the laws that have been discovered principally, or perhaps entirely, by theoretical men, so that we have nothing here which ought to disagree with what people find in practice. The only thing is whether a man has a big enough brain to apply the theory to the practice; that is the only question, and if a person had a perfect brain he should be able to evolve a dynamo-electric machine, or any other machine of this sort, out of his own mind before he had tried a single experiment. Every law of electricity necessary to be known is already known, it is only a question of the brain that has the power to evolve the perfect machine, and when they say that theory does not agree with practice, it is nottrue: it means that we have not got brains enough to apply the theory to the facts and get at the result. (Laughter.) It is impossible, of course, for a man who is finite in all his faculties to do this perfectly, and therefore we find more or less of a disagreement, and the machine becomes more and more complicated, and we have to consider too many points. In considering one point we lose sight of another point; our minds are not large enough to grasp the whole machine, and balance these various conflicting—I will not say forces—but various conflicting ideas. We cannot get a perfect balance, and that is the reason that after making a machine we have to try it to see whether it is going to work. But the ideal of this whole matter is to evolve from one's mind a perfect machine, taking account of everything, set it to work and it goes. That is the idea, and if we cannot do it it simply shows that we are imperfect in our faculties so that we make an error.

Prof. E. J. Houston: This seems to be a question as to difference between theory and practice, and I differ from the president in his remarks. I doubt whether the statement that he made will be taken as substantiated, that we know all about the laws of electricity. I doubt, indeed, whether it will be possible to ascertain the laws of electricity, except by the method of experiment. In my mind it would be impossible to divorce practice and theory, and theory and practice, whichever you put first. Theory comes as the result of practice, and all that precedes that is hypothesis. We may speak, then, of the hypothetical man, but we ought not to speak of the theoretical man, until the theory and practice thoroughly agree. A great deal that passes as theory ought strictly to be ranked as hypothesis.

Dr. Vander Weyde: That question may be stated in a few words; theory and practice must agree, and if they don't agree our theory is incomplete.

The President: This subject is not upon the programme, and I did not mean, in stating my views on this subject, to raise a storm of this kind. Perhaps I had no right to bring it up at all, and furthermore, no right to permit a discussion upon it. I don't suppose if we were to commence on that subject we should get through during the whole day, we might spend the whole day in discussing that subject. By experiment we find out the true theory. Of course I meant that we shall have experiments in our laboratories. The whole thing is based upon experiment—that is understood. If this is a question the Conference would like to discuss it can be put upon the programme, perhaps for to-morrow.

The first subject upon the programme is "The Electrical Transmission of Energy." I understand that Professor Nipher has something to say upon that question, and I will therefore call upon him.

Professor F. E. Nipher: Mr. President and Gentlemen: I feel that perhaps in saying what I say this morning I shall be giving a somewhat special direction to this discussion; and my reason for doing so, is that I wish if possible to have the benefit of whatever criticism you may have to give in the way of comment upon what I shall have to say. Some time last year I began an experimental investigation of an electrical generator and a motor with the view of determining the relations between the quantities that were involved. Perhaps I could bring out my ideas more clearly if I were to put them in the form of a graphical solution of the problem. I cannot say but that much of the ground has already been passed over in a more or less fragmentary way, and the object of the present discussion is to make a re-examination of the whole subject as completely as possible.

Suppose we have two machines, A running as a generator. Let G represent the number of revolutions per minute of its armature. And another machine B running as a motor, the number of revolutions of which being represented by N. If we now run B as a motor without any load on its pulley the relation between the speed of the two machines will be represented by a straight line, this (indicating a height upon the vertical axis) being the motion of the generator when the motor is just about to start. If we put a load of one pound upon the motor the generator will be brought to a still higher speed before the motor starts. The relation between the two speeds will be again represented by a straight line. The greater the load upon the motor the further up these lines will be drawn. L will indicate the load, which is constant on the motor. Now, this point being determined, suppose that the two machines are connected with dynamometers of the form suggested by Prof. Brackett in such a way that the power applied to either of the machines may be determined when it runs as a generator, and the power yielded by the motor being measured, let us say, by a brake. Then this determination, together with the dynamometer observations, enables us to determine the amount of power which is applied to the generator and the amount of work which is delivered by the motor. Of course, by making the corresponding electrical measurements the friction and so forth would also be determined.

I shall speak mainly of the total work which is applied to the generator and which is delivered by the motor. I will say that the brush friction and all that kind of thing will be counted in. We will have then, let us say, three surfaces determined by these observations, the one surface being that of the useful work delivered by the motor. That is to say, at each point on these lines we shall be able to construct the ordinate which will determine a point in the surface of useful work delivered which we will call W'.

In the same manner we get the surface of total work applied to the generator, and if we let that be represented by W, we can represent by their ratio the efficiency of the couple. The efficiency surface can also be laid off in this way. Now the section of these three surfaces, making G constant, is the so-called "cap section."

We shall have a gradual increase in the work delivered, which will at some speed or other of the motor reach a maximum. The total amount of power given to the generator will be represented by a line drawn in this manner (indicating), near a straight line. In fact so near so, with the machines that I have worked with, that it could not be considered anything else but a straight line.

The efficiency surface will be represented in the section by a curve running between to a maximum like this (indicating), and going down to zero at this point. That section is well known. It is simply a section of these three surfaces. The lines of equal efficiency are more interesting than the lines of work delivered. The lines of equal efficiency will be represented on this plane as contour lines. This is the first line (indicating), and you see how it is zero here because the motor does not revolve, and zero here because it carries no load. Over here we have represented the high rate of speed, corresponding to the small load. These lines on the other side represent a similar set, if we were to reverse the machines, driving the motor as the generator. We should have a similar set of surfaces on the other side which would be symmetrically placed if the two machines were alike. These lines would be parallel with equal machines, and would always diverge if the machines were not alike. The distance between these two lines would be increased by putting in a line resistance, and if the two machines could be made reversible, the lines would coincide, and the two surfaces would touch each other at that point.

Now, suppose that we have reached this point where the generator is running a motor without a load. If we put a belt on the motor and cause it to run at a higher speed, then, of course, it will require less power to drive the generator, and at a certain point the back current produced by the revolution of the machinery will exactly neutralize the current given by the generator. In other words, the current will become zero at that point. Suppose that E represents the surface of useful work delivered, and E' represents the other surface. Then suppose we increase the speed of the motor to a still higher degree, we shall pass into the corresponding surface on the other side through a region where the power is applied to both machines, and the curve will continue in the other surface. Here is where the machine B, driven as a generator, will just drive the other when unloaded. The pull on this machine is a minus quantity, because it is in opposite direction to the force applied on the brake-arm. Now, at a point mid-way (of course, whether midway or not would depend upon the two machines) the work applied is simply that of friction. To the efficiency curve we can give no physical interpretation in this case, because the signs of the two works are unlike.

When we pass into the other section, the other sheet of this surface becomes the surface for W, that is to say, the total power applied. We are going through this surface, which may be called the negative surface, in a direction at right angles to the cap section. In this direction the surface of efficiency is also a maximum, but the surface of useful work delivered has no maximum. That is to say, these lines run upward, but do not pass through a maximum.

My proposition was, to examine and determine, first, the constants for these surfaces, as accurately as possible for certain types of machines, taking some one machine as a standard, comparing others of the same type with it, in such a way that these constants may be determined as quickly as possible, so that I should get the empirical formulae which would be sufficiently comprehensive to represent the whole case, and which would be more manageable perhaps than those which have been theoretically deduced by Clausius, and which are really approximations. It would also be advisable to experiment on different armature-types of machines; for instance, the Gramme, which is the one I have already used, and perhaps the Edison machine. I have simply presented these views of the work in order to find out what may be thought of it by the members of the conference. It seems to me worth doing, but I would like to hear some other opinions on the subject.

Mr. Sprague: I would like to ask how these machines were tested; and I would also like to ask as to the Gramme machines, how they were excited, whether the field magnets were in a series with the armature, or whether they were in compound.

Mr. Nipher: They were in compound. I think in some of our machines we found some of those lines to vary very differently from those of the series wound machines.

Mr. Preece: I would like to refer to a matter touching upon the electrical transmission of energy, which I think possibly may interest the members of the conference, and that is the transmission of currents of electricity for the purpose of producing artificial illumination. You have in practical use in large cities in this country various types of machines for electrical lighting, and large plants where the electrical energy produced at one end of the line is sent out to various points along the line for the purpose of utilizing it and converting it into luminous or radiant energy. Some of the lines I know from experience amount to as much as twenty-one miles of No. 6 copper wire used in systems of arc-lighting. It therefore becomes a matter of no little interest in considering the efficiency of the dynamo-electrical machines to consider their efficiency, not so much as regards their ability to convert mechanical work into electrical energy, but also, in another sense, you might say, of the ability of the electrical energy so produced to be readily transmitted into radiant energy. This is a matter of exceedingly great and practical importance.

The question to my mind is not as to what is the best type of machine for producing the highest possible equivalent of electrical returns, but as to what is the best type of machine for producing that kind of electrical energy which can be transferred to a distance, and which can be most economically converted into light. This, of course, would necessitate the consideration of whether, according to the knowledge we have, we can progress much further and utilize incandescent or arc-lighting. We will take up first arc-lighting (I am merely suggesting this as a matter of thought to the conference); and this idea would appear to come up whether it were not absolutely necessary in taking into account the economy of the dynamo-electrical machine, to consider the number of foot-pounds of energy absorbed by the machine and returned not in electrical energy, but as returned in candle power at the lighting point. Suppose a given amount of energy was present in the electrical current; the question would be which would give the most economical return of light, a high electromotive force, or a low electromotive force. I throw this out simply as an idea; I would like to have any gentleman who has any remarks to make, take this point into consideration.

Prof. Nipher: I observe that I left out one thing which I intended to bring in, and that is, that the lines of efficiency are represented by lines which rapidly increase in distance from each other; that is, the distance between successive lines of equal efficiency become further and further apart. The lines of that surface determine the difference of efficiency at maxima and minima points.

Here we will say that the efficiency is twenty per cent.; much greater efficiency cannot be obtained under these conditions in the generator—running at a high rate of speed and the motor carrying a heavy load.

The line giving the maximum work is also a straight line or very nearly straight, and very nearly bisects the other horizontal lines.

Professor Forbes: I would merely remark that I think it is a pity that a discussion on Prof. Nipher's paper should cease immediately, although it seems almost necessary that it should do so. It seems impossible in the brief way in which he has brought it before us, to grasp the full bearing of the experiments made and the conclusions to which the experiments have led him. But it would seem that such an intensely suggestive method as he has brought before us should have a greater amount of discussion than it seems likely to have, owing to this fact, that considerably more attention than we are able to pay to it from the brief description which he has given us is desirable, and also, from the fact that the subject is a new one.

I think it is very desirable that Prof. Nipher should let us have the benefit of the results of his experiments, and the conclusions, in order that we may be able to incorporate them into our work, and into our further considerations of the subject, if we find it desirable to pursue the same investigation, or if it is to be carried on in future. It seems to me that we should have some further discussion on this subject.

Prof. Nipher: I would like to say, Mr. President, that it is my intention to carry on this work, and I presume I shall put the greater portion of next year upon it, provided it is not said that it has already been done or that it is hardly worth while to do it. I do not know but that a remark of that kind would discourage me a little.

Mr. Sprague: I would like to make one comment on what Mr. Nipher has said. It might go to the question of efficiency. We have to consider not only that the dynamo itself should be reconstructed, out of which you can get only a certain percentage, but also the very fact that its energy must be distributed over long circuits. Take an underground system or overground system, which may be readily carried over a square mile of territory and with a per cent. of loss not exceeding ten per cent. with recently constructed dynamos. The electromotive force of the generators must be very high, otherwise we are led to the fact that we are obliged to use underground conductors which must be of such large size that our space over which the energy may be transmitted for lighting would be altogether too large to enter into any commercial consideration at all. The same way for arc-light circuits. We must there deal with very high potentials. Because we use high potentials we can use much longer lines and smaller conductors. Mr. Preece speaks simply of the use of arc light circuits for the purpose of illumination. I think just as wide a purpose would be that of transference of power, and those motors which can be perfectly self regulating can be brought into circuits with arc lights and run just as efficiently as arc lights are to-day. They will be just as self-regulating and perfectly controlable as the arc lights are.

I want to touch upon one point of electrical railways which nobody seems to have a desire to do. I wish to place myself on record as to what I think the future of the electric railway is going to be in this country, and that is, the high potential circuits are going to be used. The idea has been brought forward of low potential circuits to be used for short lines or long lines; and these potentials have been taken so low as 30 or 40 volts. Also the suggestion is to use one of the rails for conducting the return circuit. These questions will have to pass through the same stages as they have in electric lighting. We started out with one conductor and used the gas pipes as a return. We are using now closed metallic circuits for all kinds of lighting, whether arc or incandescent; and precisely the same thing will be done in the electric railway. The rails will not enter on any great line as one part of a circuit; there will be used a closed metallic circuit and a potential of four or five hundred or a thousand volts, and sometimes as high as two thousand volts.

I will give an instance in which low potentials are used and the disadvantages of such. The greatest maximum mechanical effect is when the counter electromotive force is one half the initial. Let us take the electromotive force of 50 volts; I suppose that is high enough. The greatest mechanical effect is when the counter electromotive force is 25 volts. We want to transfer ten horse-power, say over any appreciable distance. We average say 800 Watts per horse-power, when it comes to practice, 746 are the correct figures. If we are using ten horse-power, we have got 8,000 Watts to take care of. The electrical energy is the product of the current by the electromotive force. Our current will be 320 ampères. In other words, in order to get that initial electromotive force of our motor of 50 volts, where our motive power has the greatest mechanical efficiency, we have got to use sixteen thousand Watts to transmit ten horse-power. Suppose we transmit that over 500,000 circular mills, that is a very fair-sized conductor. Suppose we have a single mile over which to transfer from our motor through our conductor and back again. In other words, we have something over 10,000 feet. The resistance is not less than twenty-three hundredths of an ohm to and return from our generator. The resistance of the generator with an electromotive force of 25 volts and 320 ampères of current would be about .073 of an ohm. We have got a resistance in our conductors which is three times that in our generator, with the generator working at its best mechanical effects. We have got not less than one-sixth of our energies supplied to the generator used up in the motor itself. We are going to have a very low electromotive force because we are going to have safety;

but we have got to start with 124 volts at the terminals of our machines. I think it is not necessary to go into the question of longer distances when we are dealing with 50 or 100 or 200 horse-power at low potentials. We must use 500, 1,000 or 2,000 volts, it is perfectly certain; and the rails must disappear from parts of the circuit and many safety devices be introduced to take care of the high potentials.

The President: I call upon Mr. Preece, of the Postal Telegraphs of England, to say something in reference to storage batteries.

Mr. Preece: Mr. President and gentlemen, I have been called upon somewhat unexpectedly to open a discussion on this question of storage batteries, and I regret very much that I have no notes with me to refer to, and that I shall have to trust a good deal to my memory. As I am not possessed of a poor memory, I don't think I shall develop any very serious error, although Mr. Edison himself has declared that this question of storage batteries has the most remarkable power of developing man's latent capacity for lying (laughter).

I very much agree with Mr. Edison's definition, for I think there has been more lying and more swindling and more rascality done over this question of storage batteries than over any other department of electrical science. Now these batteries have been very improperly called storage batteries; I very much prefer to call them secondary batteries. This subject of storage batteries is one upon which there is a good deal of misconception, which has arisen from the introduction of the word "storage."

These secondary batteries have been before the world for over twenty years, and all the physicists who go to Paris almost invariably meet with Planté himself, the father of this instrument. For the past 20 years, nearly, it has been one of my great pleasures when I visited Paris to pay a visit to Mr. Planté, who has shown me as he always shows everybody who sees him, the progress that he has made. Until a Mr. Faure conceived the notion of coating the plates of lead with the red-oxide of lead, these secondary batteries had not attracted much attention, although Planté's papers deserve the most careful consideration from all electricians. Mr. Faure found that by coating the positive plate of the secondary cell with a layer of minium, which is the red oxide of lead, he considerably hastened the production of the plate. Planté himself simply depended upon the electrolytic action of the current in per-oxidizing his plate. This was an operation that sometimes involved months. Faure found that by simply coating the positive plate with a layer of minium, that the time of preparation of two lead plates—a per-oxidized plate and a pure lead plate, was lessened very considerably indeed. Unfortunately, it fell into the hands of a man who put forward one of the most diabolical schemes that Paris has ever produced. A man by the name of Phillippart placarded all Paris with the most outrageous notices of what this great battery was going to do. Batteries were to be distributed, like milk and ice, at our doors, so that motive power could be obtained and used in our houses, and light could be obtained from them. The result was that a considerable sensation was created, and an attempt was made to bring out a financial swindle, but it did not succeed. Another gentleman was associated with him by the name of Volckmar. They became associated in London with a gentleman who holds a very high position, and occupies in the financial world a very important place indeed, as the head of the great firm of Mathie, Johnson & Co., who are large metallurgists.

Mr. Sellon joined himself with Mr. Volckmar. They brought out a compound battery, and a company was formed in London to develop this scheme, and a great deal of money was collected, but all of it has been lost. Mr. Volckmar himself succeeded with his part of the plunder sufficiently to ride about London in a manner indicating a person of great wealth. The fate of this man was sad indeed, for about a month ago his body was found in the Seine with a bullet hole in his forehead. Now two or three other men had been working at this idea—Profs. Tribe and Gladstone. They approached the matter in a truly scientific spirit; investigated it most carefully, and have determined the chemical actions which take place and developed the laws. The result has been that Mr. Tribe himself has brought out a form of secondary cell, although it is not yet in the market, that is a great improvement upon anything that has ever been brought out before. But all these persons have been working silently upon this subject, and have gone back to Planté's original work and have followed Planté's original method. The batteries that I am going to speak about are merely modifications of Planté's simple lead cells, the simple cell being two plates of lead placed in dilute sulphuric acid, one plate oxidized and the other plate pure.

Now, as regards the uses, I have made a great many experiments with these secondary batteries, and first I will speak of their use in telegraphy. Some time ago the idea was mooted that a considerable economy might be effected in the working of telegraphs if dynamos were used for that purpose. The dynamo machines are used by the Western Union Co. to work their circuits centering in New York. We tried them in England, but they failed with us, and for a very obvious reason, which is simply this, that in England we do not work with "closed circuits." We work our instruments with rapid reversals. Our automatic system, which is very extensive, is worked sometimes at the rate of 300 words per minute, with very rapid reversals of very minute currents, and it is absolutely essential that these currents should be uniform in their character. Now the currents produced by the dynamo machines are not uniform. If a telephone be inserted in a secondary circuit, of which the dynamo machine forms the primary circuit, you will invariably find, as I have done with the very best dynamos I have tried, that you can hear sounds which are indicative of variations of the current, and these variations are fatal to a fast speed of working.

But when you use a dynamo and utilize the current from it in preparing a secondary battery, you then get a means by which you can produce currents of absolute uniformity. The secondary battery current flows out absolutely uniform. And again, it has the great advantage of giving you a battery with a very low internal resistance and a very high electromotive force. The electromotive force of an ordinary secondary cell of Planté's form is two volts. You may take it as a rule to be two volts; its internal resistance may be made whatever you like. I had a series of secondary cells made, one set being a Faure-Sellon-Volckmar and another Dr. Tribe's, and the third set being simply Planté's. There were eight cells to each set. From each of these sets forty circuits were worked. That is, each battery had forty distinct and separate circuits, so that practically we had a hundred and twenty circuits running from these three secondary batteries. Although all worked for about three months (I think the exact time was 96 days) uniformly and perfectly, with no trouble that would necessitate even the glancing at them during this whole period of three months, without attention whatever, suddenly one failed, and immediately afterward another failed, and then the third failed. They were charged up again, and then they went on for another three months. (I did not repeat the experiment on the Faure-Sellon-Volckmar one) and they have behavied as well as one could possible wish; so much so that one of the first duties that I wish to discharge on my return to England will be to arrange for a large supply of these secondary cells and for their use on a large scale at our General Post-office. We have in use at the General Post-office in London six hundred and fifty circuits centralizing there, and we are now utilizing about twenty-two thousand cells. I think it more than likely we shall be able to work the whole of those circuits with probably not more than five thousand secondary cells. We will still have to use a considerable number of cells for certain circuits, and for local batteries, but I have no hesitation in saying that the secondary batteries were absolutely perfect and that they will result in a very considerable economy.

Now, as regards electric lighting, I have already used secondary batteries for electric lighting. I have used them in the Post-Office and I have used them for my own house. My house is in a portion of the country through which no lines pass for the purpose of electric lighting and they cannot be found within a reasonable distance, so if I want to light my house by electricity I must be dependent on my own supply of electrcity. I light my house by gas, but I burn my gas in my garden, and I extract from it that which I want; namely, light, and I discharge into the air of my garden that which I do not want—namely, poison. My gas is employed in working a small gas engine of two horse-power. It is the gas engine which works a small Gramme dynamo, which, when worked at its full power gives me forty-two volts and fifty-two amperés. These fifty-two amperés are directed into seventeen cells; the cells are Planté's original cells. The plates themselves are two feet square and in each cell there are twelve of these lead plates. The lead plates are made up of four thin sheets of lead, each sheet being about one-thirty-secondth of an inch thick, and they are perforated in squares regularly all over and these four thin plates are tied together, almost woven together, with thick worsted, and I will tell you the reason presently for that worsted. They are arranged in pairs, six on one side forming one pole, and six on the other side forming the other pole. They are placed inside of an ordinary pitch-pine box, well pitched inside, and the insulation of the cell is maintained by a thin India rubber bag, which envelops the plates. It is a loose India-rubber bag, about the same shape and size as the cell, so that when the plates are put in they force the India-rubber out, and the bag takes the exact form of the cell, and gives a cell thoroughly watertight and thoroughly electricity-tight. I have seventeen of these cells all arranged in a series, and my engine, which generates these currents and charges this battery, is in my garden. My gardener has the gas-engine under his charge; he is an ordinarily intelligent gardener. When he comes on duty in the morning he lights the gas in the gas-engine and starts the dynamo which charges my battery, and, when he goes away to his dinner, after the engine has been working for three or four hours, the battery is prepared. I go home in the evening. I have got a store of electricity. I have every room in my house fitted up. I have at my bedside a most charming little light, with no smoking and no trouble with a wick, and no heat; a mellow light by merely turning on my tap. I have the softest and most delicious light you can conceive of, thrown upon my paper or upon my book. I have had this going on for four months, and I have never had any bother except on one occasion when the gardener put his foot on the wrong place and the head of the gas engine came down upon his foot, crushing his toes, and the poor fellow has had to lose four of his toes. Their removal reminds him of the dangers of electric lighting. (laughter). It would be impossible to estimate the importance of the use of these storage batteries. I have a strong impression that for all isolated places similar to mine, that the storage battery is an essential thing, and I think that some one is bound to work out this question. Several are now pegging away at it. Sir William Thomson spent much time in investigating this subject and has given it a great deal of attention, but has not succeeded simply because he confined his attention to the Faure-Sellon-Volckmar form of battery. I confined my attention to the plain, simple Planté cell, untramelled by any patent. It is at your disposal, and nobody will interfere with you. If anybody else chooses to follow my example I think they can do precisely the same thing. But there are, after all, one or two other uses for secondary batteries, I have been very luxurious and very extravagant in carrying out this arrangement; for instance I have a little daughter who has a very pretty doll house. Her doll house consists of six rooms, and each room is well furnished, and well populated with charming little dolls. So it is necessary that each room should be supplied with a charming little electric light. So each room is so supplied with light.

Then I have a cigarette lighter which consists of a spiral piece of platinum which can be rendered red hot by the secondary battery. The difficulty in doing that sort of thing with the usual mode of distribution is, that you want to be able to cut off a portion of your current. Suppose you have your house fitted up with fifty-five-volt lamps, you don't wish to send that whole current through a doll's house or a cigarette lighter. I do this:

Here is a circuit having an incandescent lamp, and in that lamp you have a current flowing, say of six-tenths of an ampère. By putting into the circuit a secondary cell by means of a switch, that diminishes the light by setting up a counter electromotive force of two volts for the time being. While that cell is in the circuit your light is a little dim, but when I connect with the poles of that secondary cell two wires in connection with a piece of platinum wire, then a current passes through which is due to the two volts from the secondary cell. This piece of platinum wire is heated up by the current quite sufficiently for the purpose of a cigarette lighter.

So also, I have my microscope fitted up with these lamps, and I extract a current from the main circuit by means of the secondary cell, which gives me quite sufficient light for my microscope; and it gives me quite sufficient heat for my cigarette lighter, and by having a larger cell than this, I am able to extract quite sufficient power from my main circuit to light up my doll-house.

There is another field in which satisfactory experiments have been made with secondary cells, and that is in lighting up trains of cars by electricity. This has been done on one of our railways between London and Brighton. The railway company has been for some months past lighting up one of its express trains by secondary batteries. The dynamo is worked by the motion of the wheel, and charges up the battery during the time that the train is working, and the current is being extracted from the battery so that you have a light in your carriages which is perfectly steady and quite independent of the motion of the train. That leads me to a point which I omitted, and which led me to work so hard at secondary batteries, and that is that a secondary battery renders the current produced by the inconstant engine and the inconstant dynamo perfectly steady.

If your engine is unsteady, its pulsations will increase or decrease the light in the incandescent lamp, producing a flickering. This has been a fatal objection to the use of gas-engines. They are very irregular. You can see every revolution of your gas-engine, as, for instance, the Otto engine, with only an explosion at every other revolution. The Clerk engine is better, because you have an explosion with every revolution, but it is so unsteady that you can always detect the flickering in the lamp. But if you insert into the circuit a series of secondary cells, whose electromotive force shall be similar to the electromotive force required for your lamps, then you steady down your current and your lamps work with absolute perfection.

It is a difficult thing to say that in making an appliance of any kind, we have reached absolute perfection; but I can say this: That when you have a good secondary battery inserted in the electric light circuit, it renders your current uniform, and your light is as near perfection as you could wish.

Suppose that your lamp requires fifty volts, then you will require twenty-five cells, which may be plain, simple lead plates. They may be very small, and cost you a mere trifle. I should think, myself, that it would be quite possible to make cells for this purpose at a cost of not more than five shillings a cell. You put twenty-five of them in, and then when you join them up the first current that goes through simply charges up the lead plates—one is coated with oxide and the other is clear—and you get a counter electromotive force from that battery of fifty volts. The consequence is, no current whatever passes through the secondary cell unless it be raised up to exceeding fifty volts; and the whole current passes through your lamps unless there is a deficiency from the unsteadiness of the engine. Then the energy that is stored up in the battery passes through the lamps, making the light uniform, and in that way you get the steadying effect by the use of the secondary battery.

There are certain defects that have developed themselves in these batteries that have been gradually cured. The great defect in all secondary batteries is due to buckling; an effect due to the formation of peroxide upon the plate. A lead plate when it is peroxidized deforms itself, and unless some precaution is taken, you will find your lead plate will buckle up into all kinds of positions and the two plates will come into contact. This difficulty I have sought to overcome by supporting the two plates by means of a grate made of paraffined wood. This paraffined wood is sometimes tried, but the most effective material that I have tried is ebonite. These ebonite grates of the proper size are very light and very thin, though quite able to prevent all buckling.

Secondary cells have not been in use long enough to enable us to determine how long they will last. I have had them in use for four months with signs of but little disintegration of the positive plate. I think that the plates will have to be renewed only about once in every two years. But I do not care whether I have to renew as often as once in every four months.

The charm of the whole thing is such, and its cost is so trifling, that I will keep it in my house, and I am quite sure that all those who have worked in the same direction in regard to this matter of electric lighting will never give it up. The electric light itself has some sort of charm about it.

Objection is made to the cost of introducing it, but I have protested often and often against the comparison that is drawn between the cost of gas and the cost of electricity. The two things are not to be compared. When we indulge in luxuries we don't compare the cost of the luxuries with other things. If you want fine 1834 port, you don't compare its price with common ordinary claret. If you want to indulge in a fine pheasant, you don't compare it with the old cock that crowed before Peter. So when you have a delightful luxury like the electric light you don't want to compare its cost with that of gas or sperm candles, or any other mode by which life is shortened and ultimately destroyed.

Here we have something that in the out-of-the-way houses tends to lengthen life and to satisfy us, giving us something cool and delicious; and, I say, all comparisons with gas are utterly ridiculous.

It will not be long before these enterprising light companies will bring electricity to our doors, and we will all take it. When the public can get electricity at their doors and can get it without much cost, as indeed they can, they will certainly have it.

So that I look upon the days of gas as an illuminant being numbered; but gas as a generator of power is just in its infancy. The days of gas as a generator of power and heat are coming. At the same time electricity is going to supply light such as we want.

There are many facts connected with the working that I should have liked to have given you. I should have liked to have given you the efficiency; I have made careful experiments as to the efficiency of storage. Up to the present time I have not succeeded in getting more than forty per cent. of the power put in. I do not care if I do not get only twenty per cent. I get what I want, and that is all I care for, whatever the cost may be so long as it is within my means.

The cost is certainly within the reach of every man in this room. Every man in this room can afford the comfort which this light will give him, and an electric light will enable him to live four or five years longer in this world than he would without it. (Applause.)

Prof. Carhart:—I was very much pleased and gratified at hearing Mr. Preece's remark as to the use of secondary batteries. After all that has been said on both sides, it is gratifying to find that we have a certain and valuable method of lighting which is effective and economical. I wish also to add my testimony to one or two points which Mr. Preece has mentioned, and that is to the courtesy uniformly shown by Mr. Planté to any one who visits him at his laboratory and who is interested in his secondary battery.

I had the pleasure, with some friends, of visiting his laboratory and witnessing many experiments made with a large number of secondary battery cells. As we all very well know, his experiments have not only resulted in the invention of these secondary cells, but also the use to which he has put them has led to many absolutely new experiments. It is also a point of interest to know, as probably some of you do know, that Planté himself tried a method many years ago of covering the plates with minium. If Prof. Barker were here, he would bear witness to the fact that Planté said to us both that he tried the same thing several years ago, and found that in the end it was not so effective as the form of plates in the battery which he adopted, which, though necessarily slow, result in a better form of cell. It is gratifying to know from the experiments of Mr. Preece that we are advancing, so far as new experiments are concerned, and that we are finally going back to the original form devised by Planté.

There may be one thing which is worth while mentioning. We are all well aware of the careful and interesting experiments referred to by Mr. Tribe, on the chemistry of the secondary battery. These experiments seem to show that there is a greater or less formation of lead sulphate in the action of the cell. That also shows us why the electromotive force having run down, is recovered to a certain extent after a period of rest. A great many points have been cleared up that were certainly quite enigmatical before. Now, some experiments, and I think some of those that have been published by Prof. Barker, go to show that in the Planté cell as formed by Planté, by a rather slow and tedious process, there is only, to say the most, a small amount of lead sulphate produced. I take it, that the giving out of the cell is due to the formation of lead sulphate, so that if these cells are formed by the rules laid down by Planté, they will have a tolerably long life.

Just one word with regard to gas. You will remember that a year or so ago Professor Langley showed, I think beyond any question, that the percentage of the radiant energy from an Argand gas-burner, that is effective in producing illumination, is less than one per cent. It certainly is a very curious result. There is a little doubt but that most of the energy goes up with the current of heat through the chimney, and that less than one per cent. of the energy from the gas-burner is effective for illumination. If this is so we can well afford to recover only 40 per cent. of the energy put into the secondary cell, and use incandescent lamps by the aid of secondary cells, and still be within the economy of gas.

Mr. N. S. Keith.—Planté was evidently far ahead of his time. He produced that which is to-day found to be of vast practical importance. In 1860 or 1861, about the time of his published experiments, there was no electric lighting—certainly none as it exists to-day. There were then electric lighting men who were far ahead of their time, but it is only within the past four years we may say that we have had any practical application of the secondary battery. I am led to consider this point very forcibly because in 1878, during experiments I was then carrying on in the electrolysis of lead, and in collateral experiments which relate to the chemical action of lead in various solvents and in various electrolytes, I was led to make a secondary battery, after having made one of Planté's. I made one by coating the plates with per-oxide of lead by electro-deposition. Not per-oxide of lead formed from the substance of the plate itself, as by Planté; not by coating the lead plate with oxide of lead, or per-oxide of lead as the case may be, manually from external sources; but by coating it by deposition from a solution of lead in which the plates were immersed. I took 240 cast pieces of lead plate, of one foot square each; I divided them into ten cells making 24 plates, in each cell, 12 of which were positive and 12 negative. By using a suitable solution of lead, a sub-acetate of lead and nitrate of sodium, and by treating that with a current of electricity I produced decomposition of the solution, deposition of per-oxide on the positive plate, and at the same time metallic lead was deposited upon the negative plate, in a very finely divided and crystalline state. Some hydrogen was also deposited with the lead, an equivalent to the extra oxygen that was deposited in chemical combination with the lead upon the positive plate. These plates, after pressing the metallic lead so as to cause it to cohere and adhere to the plate, were taken from this solution and immersed in sulphuric acid, and gave a very satisfactory secondary battery indeed. At that time, in May, 1878, I ran a dynamo as an electric motor with this battery, and I effected some chemical and electrolytic decompositions in a solution of sulphate of copper, and did some other things which were then the only possible commercial applications of secondary batteries. Since that time electric lighting by incandescence has come to the front, and we find the great use of secondary batteries which has been so forcibly set forth by Mr. Preece. At that time we did not have telegraphy by the dynamo; but we had telegraphy by the use of the primary batteries with which we are all so familiar. I have since that time carried on a considerable number of experiments relating to secondary batteries.

The whole subject is an electro-chemical one. There is a chemical decomposition of the solution by the passage of a current of electricity. There is a decomposition of the water of the electrolyte either primarily or secondarily. Oxygen goes to one plate, hydrogen to the other. For a new experiment I have taken solutions which suffer decomposition, without delivering free hydrogen and oxygen. I have taken, for instance, solutions of the sub-salts of lead. Current causes decomposition and a deposition upon one plate of per-oxide of lead and upon the other metallic lead. For instance, I have taken for one plate a plate of carbon and for the other a plate of lead. A solution of a low sub-salt of lead was used as an electrolyte by passing a current of electricity through it. The action is to raise the sub-salt to a proto-salt. This takes energy, which is absorbed during and through the chemical action. When the source of electricity is removed and the circuit remade, the current of electricity is returned until the per-oxide of lead has again entered the solution and the lead has also entered solution. The action of the charging current of electricity is to raise the electrolyte to an acid condition. But the charging action is stopped before that point is reached because the end would be partly defeated in passing it.

I am also carrying on some other experiments in the way of storage of electricity, or in the use of secondary batteries. I can hardly give particulars, except this. The idea is to preserve the integrity of the oxide-plate for an indefinite length of time, say as long as may be practically worth while. So far, after some months' use, I have been able to oxidize the plate to the desired depth, say $\frac{1}{16}$ of an inch, and preserve a backing of metallic lead. Under this change, if my theory and practice be correct, I will not be obliged to replace, as in the present known storage batteries, the oxide plate.

(To be Continued.)

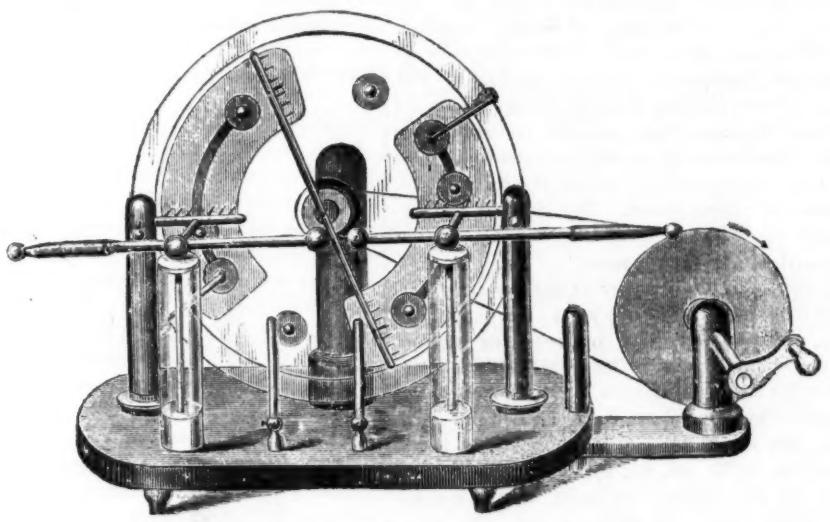
Benjamin's Voss-Holtz Electric Machine.

The principle called "mutual accumulation" prevails with Holtz plate electrical machines as with dynamos. Both are machines for giving electrical manifestations from application of power. Both require some sort of electrical charge upon which to build by means of mechanical motion. The dynamo requires to be charged with magnetism (an electrical condition), and the plate machine requires that one of its plates be charged statically before it will respond electrically to the energy expended in rotating one or more of its discs.

These machines have been called "convection-induction machines," because they depend upon an initial charge, even though small, which acts *inductively* to produce other charges, which are *conveyed* to some other point where they can increase the initial charge, which last may be furnished to a suitable collector and conductor.

The dynamo has its field-magnet charged, and this charge acts inductively to produce electricity, which in its turn is conveyed to the magnet to increase the induction on the armature, etc., etc. Holtz-plate machines may be considered, comparatively, to be as much of an improvement over the older cylinder and plate machines of Franklin and others as is the present dynamo over the magnetos of Pixii and Clark.

To Nicholson, Sir W. Thomson, Töpler, Holtz and others much credit is due. But even they did not produce the perfect machine, as it has been improved by several in its mechanical construction. This fact is noticeable in the Voss-Holtz machine made by Mr. E. B. Benjamin of No. 6 Barclay street, New York city.



BENJAMIN'S VOSS-HOLTZ ELECTRIC MACHINE.

The accompanying illustration gives a good idea of the machine. It will be seen that the apparatus consists, like the Holtz machine, of two glass discs, unequal in diameter of which the larger is held in a fixed position, while the other is mounted upon a horizontal axis and can, by means of multiplying gear, be rotated at a high velocity. To the front face of the the larger plate are attached two pairs of tinfoil discs, as shown, each pair being connected together by a strip of tinfoil, and by a second strip to one of the two bent arms, by which they are connected to a light metallic brush directed toward the front face of the rotating plate.

At the back of the fixed plate are pasted two paper coatings, which correspond to what used to be called the paper "armatures" in the Holtz machine. To the face of the rotating plate are attached, at equal angular distances apart of 60°, and at a short distance from the circumference, six discs of tinfoil about an inch in diameter, corresponding in position and size with the tinfoil discs upon the fixed plate; that is to say, if the discs were numbered in rotation, 1, 2, 3, 4, 5 and 6, those numbered 1 and 2 would, in a certain position of the rotating plates, correspond and be opposite to one connected pair of discs of the fixed plate. Nos. 4 and 5 would similarly correspond to the other pair, and Nos. 3 and 6 would have no discs on the fixed plate opposite to them. To each of the little tinfoil discs, on the rotating plate and concentric with it, is attached a metallic button of the form of a plano-convex lens, and these buttons, in the revolution of the plate, pass under and are lightly touched by the metallic brushes which are held by the bent arms, the brushes being so adjusted as only to touch the buttons and not to come in contact with the glass of the rotating plate to which they are attached. There are two horizontal collecting combs, insulated from one another by being attached to a horizontal bar of ebonite, but connected respectively to the two discharge terminals in the front of the instrument by the horizontal bars shown in the figure, and the distance between these terminals can be varied at pleasure by sliding them through the balls which are attached to the inner coatings of the two cylindrical Leyden jars, by which the charge is accumulated, and the discharge intensified. Across is a vertical bar of brass carrying at each end a comb, directed toward the rotating plate as well as a pair of metallic brushes, similar to the others, and which also, in their turn, make momentary contact with the metallic buttons, as they pass between them, and at a moment when they are not under the inductive influence of the metal discs of the fixed plate.

The marked improvements made by Mr. Benjamin, beyond superior workmanship, are these: He supports the collecting combs by means of two substantial standards made of solid ebonite, so that the main standard which supports the stationary plate and carries the hub of the rotating one is relieved from strain, which takes place from moving the electrodes. But the main improvement is under a patent granted to him. He places on the periphery of the positive-electrode sphere at the point nearest the negative sphere a small piece of insulating material, ebonite for instance. The effect is to stop leakage, so to speak, of the electricity. It is retained until a sufficient charge is obtained to give high quantity effects. The visible result is a strong, thick spark, much larger and stronger than without the insulating tip. The price varies from $25 upwards, according to size. □

The Pan-Electric in Texas.

To the Editor of The Electrical World:

SIR: From the amount of veracity contained in your item concerning the Texas Pan-Electric Telephone Company in issue of Oct. 4, I judge it must have emanated from Mr. Watkins himself. Their progress in Texas is the reverse of rapid. Fort Worth is the only place in which they have done anything whatever except to talk and petition for rights of way. Everything that could be done by mouth and through gullible newspaper correspondents has been done to excess, but anything toward purchase of material, except in the single case of Fort Worth, the reason of which is very apparent, as we shall see, there is no outward evidence observable to me.

That they have "several territorial lines in operation and others being built" is an utter falsehood. They havn't a mile of such line built in the State, nor is there any evidence of their intention to build such lines, as far as I can see. The Mayor of Ft. Worth is the President of the Texas Pan-Electric Telephone Co. After having tried in several cities of the State to organize stock companies, to build exchanges, evidently without success, the "parent" company of Ft. Worth have concluded that they must make a show of having confidence in their own concern by putting a little money into it themselves, a thing they seemed to have avoided as long as they could safely do so.

But it looks as if their boasts and promises had forced them into doing something, and they are putting up some poles in Ft. Worth. The Erie Co.'s Exchange in that city has about 250 subscribers, the most of whom, I believe have paid their rental for the next quarter. I do not believe the Pan-Electric Co. can show contracts with fifty subscribers.

I presume the action of Mr. Watkins in Galveston is a fair sample of their modes of operation elsewhere. He represented to Messrs. Graham and Jones and another subscriber to the Erie Exchange in Galveston that he had permission from the Erie Co. to try his machine on their lines, which was, of course, absolutely untrue. When discovered and cut off by Central office, Mr. Watkins appeared in search of the manager, who, as he probably knew before commencing his test, was out of town. Being unable to obtain permission from any one at Central office, the munificent gentleman offered one of the lady operators a dollar to secure non-interference. Perhaps you can imagine that lady's disgust!

It has not been the policy of the Erie Co. to pay any attention to their boasts and promises. The people of the State can see for themselves how little is being done, but I take it upon myself as an individual not to permit them to pervert the fountains of electrical information, so to speak, by any such astounding statements as were furnished for your issue of Oct. 4. FOSTER.

GALVESTON, Tex., Oct. 8,

The Electric Light in Theatres.

In our last issue we spoke of the popularity of the electric light in New York theatres. A reporter of the *Tribune* has now made some painstaking inquiries among the managers, and details the results in an article of a highly encouraging nature. He notes that the direct system of electric lighting is being rapidly introduced into theatres and is a formidable rival to gas. One company alone has in use over ten thousand incandescent lamps in the largest theatres and opera-houses in Europe, and in the United States within a year has put sixteen thousand more in places of amusement outside of New York. The managers of the principal theatres here have until this season contented themselves with gas light. Each house employs its own gas engineer, who has entire charge of the lighting department. The cost of lighting during the season of forty weeks varies from $75 to $150 a week, according to the size of the house and the character of the plays produced. Theatres that are open the year round, like the Casino and the Madison Square, have proportionately greater bills to pay. The roof garden at the Casino figures largely in the lighting account of that house. To the cost of the gas and the necessary labor must be added that of the calcium light, which no first-class theatre is without. The average cost of lighting will probably exceed $4,000 a year in most theatres of this city.

Six of the largest consumers of gas in this field have adopted electricity, all but two within a comparatively short time. A large number of electric lights at the Eden Musée have been in continuous use for six months. J. G. Sarter, the business manager, said, "On the score of safety and comfort the light speaks for itself. We have 340 lamps in use twelve hours a day, every day in the week. From careful calculations I estimate that this is equivalent to a daily consumption of 22,300 cubic feet of gas. Imagine the effect on the atmosphere and decorations of this room of so great a fire kept continuously burning and giving off, besides heat, waste products in the shape of water, sulphur, ammonia and carbonic acid. See, too, with what superiority these little globes lend themselves to the display of our various tableaux. By enveloping them in tissue paper of different shades and disposing them at the desired angle we get the height of realistic effect, without shadows. We used gas at first, and endeavored to convey the light in the same way by means of rubber tubes. But the fire authorities interfered and made us remove the tubing, which was after all not suitable to our purpose."

"But would it not be much cheaper to use gas from the street mains than it is to manufacture your own light?"

"You shall see. We have a fifty horse-power engine, run by our own engineer. Here is the daily expense account itemized for the first six months. I have computed interest and depreciation on plant at 6 and 10 per cent. respectively: Coal, $6; labor, $4; lamps renewed, $1; interest and depreciation, $2.25; oil, $1; total, $14.25. This is equivalent to gas by my former estimate at sixty-three cents per 1,000 cubic feet. In other words, the same amount of light would cost us at present prices for gas over $50 a day."

At Koster & Bial's Concert Hall 240 incandescents have recently taken the place of gas. A ventilating fan in the vestibule is run by an electric motor, the power being furnished by a current sufficient to light a sixteen-candle lamp. Mr. Bial said: "Our gas bills have sometimes exceeded $300 a week. This interior, frescoing, hangings and everything have been literally burned out every year by the gas consumed to light it. The difference in temperature is very noticeable since we turned on the electric light. I think the cost is about one-third less than gas supplied by the Municipal Company. But there would be economy in using it even if it came much higher."

A visit to the theatres on the east side and conversations with several managers show a remarkable unanimity of opinion as to the advantages of electric illumination. The manager of the National Theatre said:

"I put in the electric light this season, and I wonder now how I could ever have got along without it. There is nothing in the way of scenic effect of which gas is capable that cannot be done more easily and satisfactorily by electricity. Yes; the theatre is better lighted and at less expense."

The reporter found Mr. Harry Miner at the People's Theatre. In response to inquiries on the subject he said: "I shall have the light in both my houses on this avenue within a short time. Estimates are now in preparation. It is the only light for the purpose, and infinitely superior to its older rivals. My lower house has been lighted from an arc-light station in Stanton street. It has cost me by their system probably fifty dollars a week more than for gas, but on the whole it was worth the additional expense. I propose in future to manufacture my own light and supply both houses from the same station. By this means I am convinced that I can make the light for half what it now costs me."

"You have had several fires, I am told; Mr. Miner, which the authorities attribute to the system of lighting in use in your theatre."

"Yes, that is so. But I prefer not to say anything on that head at present. It would involve a discussion of the relative merits of rival systems. I have my own opinion, however, on the subject, bought by experience, and when I carry out my new plan of lighting I don't think you will hear of any fires caused by it. There is absolutely no danger from a proper system of electric light, while the presence of gas in a theatre is a constant terror to its proprietor."

At the Third Avenue Theatre a direct system of electric lighting has been arranged with five hundred lamps, engine and dynamos, to light the house. "We have no fault to find with the light we are getting now," said Mr. Arthur, the manager for Mr. Rankin. "You observe that it is raised or lowered at will in the auditorium and that the stage effects are such as could not be obtained by a less steady and brilliant illuminant."

"Do the actors complain of the difficulty of making up by the electric light?"

"I never heard of that except where the theatre was lighted with gas and electricity at the same time. The advantages of light without heat in a small dressing-room would certainly offset any such objection."

The last manager seen was Mr. Kiralfy, at the Star Theatre, during the performance of "Sieba." "The electric light?" he said. "I have 200 now on the stage in the transformation scene. There is no limit to the startling and dazzling effects that may be produced by such means. If every theatre that we went to had it, I would not be obliged to carry my electric light machine about the country with me. But it is only a question of time when they must all use it. It is the first step that costs. After that there is no question but that it is cheaper than gas in every way."

Attachment for Arc-Lamps.

In connection with the Ball exhibit of dynamos at the Exhibition, Messrs. Wright & Travis, of 201 Duponceau street, Philadelphia, exhibited some arc-lamps operated by current from one of the Ball dynamos, and having an attachment to each lamp devised for the purpose of increasing the length of time of endurance of the carbons. The principle involved is the preservation of the incandescent

Fig. 1.

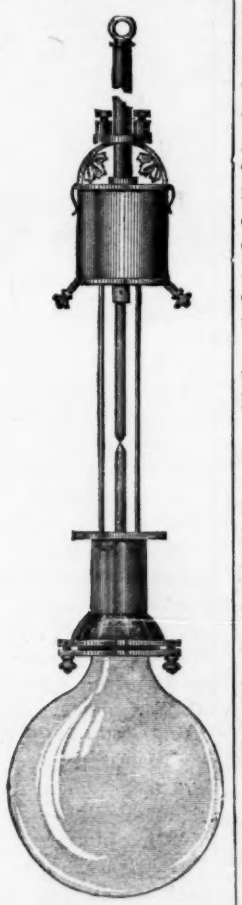


Fig. 2.

points of the carbons from access of the oxygen of the atmosphere which would otherwise hasten the consumption of carbon by combustion. Fig. 1 shows the attachment in working position, and Fig. 2 shows it lowered to renew the carbons or to adjust them. It consists of a metal cylinder, which slides on the rods which support the lower or negative carbon, and a glass globe supported from the lower end of the metal cylinder. When the attachment is raised to position as shown in Fig. 2, the globe and cylinder are fastened by turning the inclined binding posts to a vertical position to lock it in place, and thereby make the apparatus approximately air-tight, to prevent speedy combustion, due to access of air to the incandescent carbon points.

On one side of the metal cylinder is a valve which opens outward, so that when the air within the globe expands from the heat of the arc a portion of it may escape to equalize the internal and external pressures.

Infringing on Telegraphic Patents.—A bill in equity has been filed in the United States Circuit Court, says the Philadelphia *Times*, by the Gold and Stock Telegraph Company against William W. Maris, Joseph W. Dyer and M. S. Smith. The bill sets out that the complainants are the owners of letters patent on certain improvements in printing telegraphs, and aver that the defendants are infringing their rights. They ask that an injunction be issued against the defendants. The case has been put on the equity list for argument.

A Frolic by Way of Finale.

During the last days of the Exhibition, most of the gentlemen in attendance as representatives of the exhibitors, and several others whose duties required their constant presence in the building, formed themselves, by way of a joke, into the Mystic Electric Order of Kazoos. The "kazoo" is a small whistle emitting a sound of ear-splitting character, and was adopted by the Order with enthusiasm. The first effort of the new society was the publication of a primer taking off in a good humored and very witty vein the excellent primers issued by Prof. Houston, of the Franklin Institute. The primer was an immense success, and copies are now to be obtained only with great difficulty. The next public action of the Order was the presentation of a library, comprising the leading works on electricity, to Prof. W. D. Marks, the superintendent of the Exhibition, as an acknowledgment of his willingness at all times to consult the wishes of exhibitors and facilitate their operations. The presentation took place on Saturday, the 11th, about 4.30 P.M., in the Press Room, when Prof. Marks was duly initiated into the Order and informed of the kindly feelings of the members toward him. The later proceedings of the day are chronicled as follows, by the Philadelphia *Times*:

The darkness that last night enshrouded the various buildings of the Electrical Exhibition, through which over a quarter of a million people have jostled each other for a month past, was relieved by a gaily illuminated scene in the yard of the old Pennsylvania passenger station. At half-past eleven about two hundred gentlemen assembled mysteriously at that point. A cauldron of glowing coals stood on an extemporized brick pavement. It was the final meeting of the Mystic Electric Order of Kazoos, Vermilion Circuit No. 0. The Mystic High Magnet Horace E Hall, of New York, presided, while the Grand Incubator, George Sprague, of Pittsburgh, and the Grand "Semphamore," Ignatius Snyder, of Philadelphia, stood at his right and left. His Nibs, the Electric Pen, George Shaw Lockwood, read a report declaring the sacred Order had "during the Exhibition performed its functions of mystification and propagation of misinformation through the diffusion and irradiation of verbosity in a noncandescent, dissolute and chaotic manner. It points with pride to the wondrous results obtained by its grandiloquent essay, Primer No. 0. In general the non-scientific world, including the inventor of the Hell-you-tell-us, have been so paralyzed that only the curative effects of Applejack could restore them to their normal and pristine condition. It may be of interest to the members to learn that several of our mis-leading scientists have been short circuited by the application of this remedy."

The Primer issued by the Mystic Order of Kazoos, is a remarkable specimen of scientific knowledge. The following extracts will suffice:

This Primer contains an immense amount of useless misinformation condensed in wonderful and unavailable form.

I. Dynamite Electric Machines.—Dynamite electric machines may be painted a great variety of colors without increasing their efficiency. This affords scope for aspiring inventors. A dynamite consists essentially of the following parts, namely: The Painted Portion or Chromo-sphere; the Wire Portion or Whirligig; the Brassy Portion or Computator.

II. Electric Lights.—There are two kinds of electric lights, namely, our kind and the other fellow's kind. Our light is much lighter than the other fellow's light. The other fellow's light is surrounded by a cloud of non-luminous verbosity.

III. Electricity.—The identity between lightning and electricity was discovered within a convenient distance of this building by Benjamin Franklin.

IV. Electric Circuses.—There are several kinds of electric circuses. 1. This exhibition is one kind of electric circus. The Jumbo exhibited is not that humbug of Barnum's. 2. The kids who infest the building daily are another. 3. So are the exhibitors who do not smother their cusses.

V. Batteries.—The essential part of the voltaic battery is the sell. There are many kinds of sell, the most important being: 1. This Primer, which is the most complete possible 2 ct. sell of its kind, and which supplies a long-felt want. 2. The storage cell, which is the Faure-most Sell-on record, and which has recently been Brushed up to form a new Plant.

The order has proved so great a success that there is every likelihood of its permanence, and of the formation of other circuits in the various parts of the country, to which members initiated at Philadelphia belong, not only to commemorate the Exhibition but to promote good feeling and sociability among those engaged in electrical pursuits.

Underground Wires in Philadelphia.—The Western Union Company has made an arrangement with Mr. David Brooks for running wires underground in Philadelphia. Mr. Brooks says: "The company agrees to use 100 wires in the cable, which I will lay down for a term of seven years with the privilege of renewing at the end of that time. The trunk line of the cable will be on Broad street and the cables will run from the Broad street station to Third and Chestnut streets, where the Western Union people expect to establish their main office. Another cable will be run to Tenth and Chestnut streets and one from there to the Kensington station."

On a Possible Method of Electrical Communication between Vessels at Sea.*

A few years ago, I made a communication on the use of the telephone in tracing equipotential lines and surfaces. I will briefly give the chief points of the experiment, which was based upon experiments made by Prof. Adams, of King's College, London. Prof. Adams used a galvanometer instead of a telephone.

In a vessel of water I placed a sheet of paper. At two points on that paper were fastened two ordinary sewing needles which were also connected with an interrupter that interrupted the circuit about 100 times a second. Then I had two needles connected with a telephone; one needle I fastened on the paper in the water, and the moment I placed the other needle in the water I heard a musical sound from the telephone. By moving this needle around in the water, I would strike a place where there would be no sound heard. This would be where the electric tension was the same as in the needle; and by experimenting in the water you could trace out with perfect ease an equipotential line around one of the poles in the water.

It struck me afterwards that this method, which is true on the small, is also true on the large scale, and that it might afford a solution of a method of communicating electrical signals between vessels at sea.

I made some preliminary experiments in England and succeeded in sending signals across the river Thames in this way. On one side were two metal plates placed at a distance from each other, and on the other two terminals, connected with the telephone. A current was established in the telephone each time a current was established through the galvanic circuit on the opposite side, and if that current was rapidly interrupted you would get a musical tone.

A few years ago, I found that our distinguished President, Prof. Trowbridge, had very similar ideas in connection with the possibility of communicating between vessels in a fog. Using a dynamo machine for charging the water, a distant vessel might receive signals when getting in dangerous proximity to the other.

Urged by Prof. Trowbridge, I made some experiments which are of very great value and suggestiveness. The first was made on the Potomac River.

I had two boats. In one boat we had a Leclanché battery of six elements and an interrupter for interrupting the current very rapidly. Over the bow of the boat we made water connection by a metallic plate, and behind the boat we trailed an insulated wire, with a float at the end carrying a metallic plate, so as to bring these two terminals about 100 feet apart. I then took another boat and sailed off. In this boat we had the same arrangement, but with a telephone in the circuit. In the first boat, which was moored, I kept a man making signals; and when my boat was near his I would hear those signals very well—a musical tone, something of this kind, tum, tum, tum. I then rowed my boat down the river, and at a distance of a mile and a quarter, which was the furthest distance I tried, I could still distinguish those signals.

It is therefore perfectly practicable for steam vessels with dynamo machines—and most large steam vessels use the electric light, which requires a large dynamo machine—to know of each other's presence in a fog when they come, say, within a couple of miles of one another, or perhaps at a still greater distance. I tried the experiment a short time ago in salt water of about 20 fathoms in depth. I used then two sailing boats, and did not get so great a distance as on the Potomac. The distance, which we estimated by the eye, seemed to be about half a mile; but on the Potomac we took the distance accurately on the shore.

Prof. Trowbridge: I am very glad you have all heard Prof. Bell's exposition of a subject of this nature in which I think he excels all of us in America. He has referred to me in this connection, but I can only say that some years ago I published an account of a plausible method of sending signals across the Atlantic Ocean without any cable. I do not mean you to infer that it is at all practicable, but it is possible. If you will allow me for a moment, suppose this represents the two continents (making an outline of the continents). If you should have a dynamo machine in Philadelphia and ground one terminal in Patagonia and the other in Labrador, then a telephonic circuit through here (indicating) would enable you to hear signals that are made on the first circuit. It is perfectly possible. In fact, I have tried the same experiment which Prof. Bell refers to in Cambridge, at a lake called Fresh Pond. I then heard signals sent from Boston to Waltham, a distance of 10 or 12 miles, by simply having the terminals of the telephone—that wonderful instrument invented by Prof. Bell—in Fresh Pond, where they must have been a long distance away from the earth of battery.

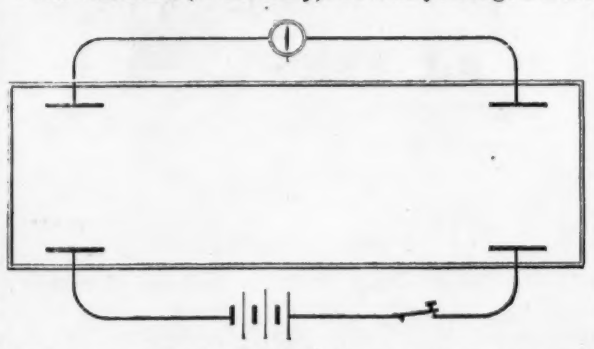
In regard to the fog signals at sea, my effort has been in a somewhat different direction. My effort has been to ascertain with galvanometers the direction of vessels which are approaching. The arrangement is like Prof. Bell's. Each vessel carries a dynamo machine, grounds one terminal of the circuit at the bow, and trails a wire, uninsulated, at the end only, over the stern. Each vessel is provided with a cross-arm and a galvanometer in the circuit, of which the terminals enter the water at the ends of the cross-arm. When one vessel comes within the field of the other, the galvanometer will show how the equipotential lines are disturbed, and if you had a careful map of those equipotential lines, you could ascertain where the other vessel was. The method could also be applied to saturating water in the neighborhood of a rock, and you could take electrical soundings, so to speak, and ascertain your place from electrical maps carefully made out.

Mr. W. H. Preece: If you will allow me the use of the board, I think I can give the section details of a real and practical experiment, which combines both the ideas of Prof. Bell and Prof. Trowbridge. In the South of England we have a charming island called the Isle of Wight. This is separated from the mainland of Hampshire by a channel of a mile and a quarter at one end and about six miles at the other. Portsmouth comes here (indicating) and is distant across about six miles. Then comes the narrow channel, called Hurstcastle, and Southampton is here (indicating). Newport, in the centre of the Isle of Wight, is there (indicating).

The Isle of Wight is a very busy place. There are several important towns, the Queen's marine residence is there, and the cable across at Hurstcastle is of consequence. For some cause the cable broke down, and it became of great importance to know whether we could communicate across, so I thought it a timely opportunity to test the ideas that had been promulgated by Prof. Trowbridge. I put a large plate of copper about six feet square in the sea at the end of the pier. A wire passed from there to Newport and from Newport to Hurstcastle and in the sea there I placed another copper plate. Opposite at Hurstcastle was a similar plate and the wire passed from there over ground to Southampton, from Southampton down to Portsmouth and then into the sea again at South Sea pier. We have here a complete circuit if we take into consideration the water, the circuit starting from Southampton to Portsmouth, through the sea, six miles to Newport, to Hurstcastle, thence across Hurstcastle, a mile and a quarter, and thence to Southampton again.

We connected the telephones in the circuit, but we could not converse by them. But when we placed at Southampton and Newport what are called "buzzers"—they are little instruments that make and break the current with great rapidity and make a buzzing sound, and for every vibration send a current into the circuit—with these buzzers, and about 25 cells of Leclanché, it was quite possible to communicate between Newport and Southampton, although the circuit was broken by six miles of sea at one end and one mile and a quarter at the other. If it had not been that the cable was repaired the very next day, communication would have been continued between the mainland and the Isle of Wight in this manner. And when the cable breaks down again, telegraphic communication will be conducted across the Solent, a distance of six miles and a mile and a quarter by the same means I have described to you to-day.

Prof. Valentiner (of Germany): Several years ago I made



a lecture room experiment which may be of benefit to professors. Take an elongated trough, and place on one side a battery with a key; then here a plate, another plate on the other side with a galvanometer in the circuit to detect the current, here a plate with another on the opposite side, finally returning to the battery with the key. If the trough be filled with water, any movement of the key here will cause a deviation of the needle of the galvanometer. It does not need a very strong battery to do that. I tried that experiment on one of the canals in Holland on a large scale, but I found that the results were very doubtful. I see now that the current was too weak.

*An abstract of a paper read by Mr. A. Graham Bell with discussion thereon, Am. Association for the Advancement of Science, Sept. 9, 1884.

A Telegraph Suit in Equity.

A suit in Equity was begun in the United States Circuit Court on Oct. 11, by several of the former owners of the American Rapid Telegraph Company against the present officers, to prevent the continuance of the latter in their positions. The complainants are James W. Converse, the former president of the American Rapid, Edward C. Wilson, J. Warren Merrill and George S. Bullens, all of Boston, and the defendants are Anthony W. Dimock, the president; Jeremy G. Case, the secretary and treasurer; and Garrett S. Mott, S. D. Houston and William J. Snyder, directors of the same company. The American Rapid and Bankers and Merchants' Telegraph Companies entered into an agreement on August 28, 1883, by which the former agreed to issue $3,000,000 first mortgage gold bonds at 6 per cent., which were to be delivered to the Bankers and Merchants' Company in return for the extension and completion of lines to Chicago, St. Louis and other places. The agreement was afterward modified so that the bonds were to be exchanged for equal par value of the stock of the American Rapid. This was accomplished through George S. Bullens, who acted as trustee. Fifty-one per cent. of the stock was thus delivered to Mr. Dimock and his associates, who were then the officers of the Bankers and Merchants'. This stock was not to be sold or transferred until 1,000 miles of line were built, but was used by the Dimock party to elect themselves the officers of the American Rapid.

The complaint alleges that the defendants have used the interest thus acquired, for the benefit of the Bankers and Merchants' Company, in which they have large individual interests, and against the American Rapid in which they have no individual interest. Among the specific causes of complaint are: substituting the signs and blanks of the Bankers and Merchants' for those of the American Rapid; the failure to require the Bankers and Merchants' Company to turn over, according to the agreement, to the American Rapid the lines already built; the placing of wires on the American Rapid poles, which was part of the consideration for the bond, and then claiming the wires as belonging to the Bankers and Merchants'; the instigating of suits against the Rapid Company; and the insolvency of the Bankers and Merchants' Company. For these reasons the complainants ask that an injunction issue restraining the defendants from acting as officers, and placing the company in the hands of a receiver.

A New Zinc Accumulator.

One cannot help being a little amused, says the London *Electrician*, at the way in which inventors are continually ringing the changes on secondary battery arrangements. M. Reynier has lately devised a zinc accumulator, which has, to use the usual formula, given good results. It comprises four large Planté positive electrodes, bent and perforated, and three negatives, consisting of smooth lead plates, which are coated with zinc by electro deposits from an acidulated solution of sulphate of zinc, in which the element is immersed. Glass tubes attached to the negatives by lead wires prevent accidental contacts inside the battery. The seven electrodes are carried by as many separate cross bars, made of paraffined wood, which rest on the edges of the cell, and keep the plates at a certain distance from the bottom. The place of a cover is taken by these crossbars, which touch one another. Each plate is provided with a terminal, the four positive poles being on one side and the three negatives on the other; and two brass rods, terminating in binding screws, connect the poles of the same name. The cell consists of two wooden rectangular boxes, one inside the other, with a space of several millimetres between, lined with a water-tight cement, supple and non-conducting, of tar base. The complete insulation of the case, and of all the parts, the purity of the metal deposited, and its amalgamation, are said to reduce to a minimum the local attack on the zinc, which was considerable in the old Nantua battery. The consequence is that what is called the *co-efficient of restitution* may now be compared with that of the Planté accumulators. The following are the leading particulars of the new accumulator:

E. M. F.	2.36 volts.
Mean resistance	0.02 ohm.
Normal intensity of discharged current	25 amps.
Intensity of charged current	5 to 10 "
Capacity of accumulation after 200 hours of formation	550,000 coul.
Effective surface of the four positive electrodes (3,100 sq. in.)	200 dm².
Effective surface of the three negative electrodes (2,015 sq. in.)	13 "
Weight of positive electrodes (18 lbs.)	8.2 kg.
" negative electrodes (3 lbs.)	1 4 "
" the cell (6 lbs.)	2.7 "
" the fluid (10 lbs.)	4.4 "
" the lead wires (1 lb.)	0.46 "
Total weight (38 lbs.)	17.16 "

The total amount of electrical force stored up is 130,000 kilogrammetres (950,000 foot-pounds), or 7,600 kilogrammetres (55,000 foot-pounds), per kilogramme (2.2 lbs.) of accumulator. Theoretically, a zinc accumulator should store up double that amount; and if this form gives less, it is—at least so is said in *Les Mondes*—because M. Reynier has designedly increased the strength of the cell and the bulk of the electrodes beyond what is necessary. It should also be remarked that this capacity of 7,600 kilogrammetres per kilogramme is higher than that of any accumulator hitherto made in France. Therefore, notwithstanding the great weight of the cell and the positives, this new form of accumulator is relatively light, which renders it suitable for use in electric locomotives as well as in fixed plant. Independently of their use as accumulators, zinc secondary batteries may be utilized as "regulating voltameters" in incandescent lighting, and for counteracting irregularities due to the piston stroke, accidental stoppages, and other causes.

Mr. H. J. Schneider is no longer connected with the McTighe Electric Light & Mfg. Co., of Pittsburgh, Pa.

The London Stock Exchange.—We learn that the well-known firm of Woodhouse & Rawson has been awarded a contract for the lighting of the London Stock Exchange, both the old and the new buildings. Duplicate plant is to be used throughout, and the work will be taken in hand at once.

Electric Lighting on a New Steamship.

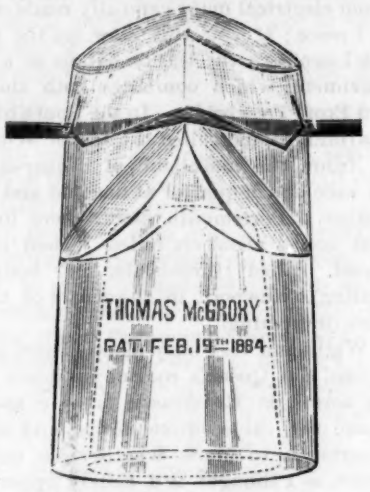
The Hammond Electric Light and Power Supply Company, Limited, has fitted up one of Mr. James Laing's new vessels, says the English *Electrical Review*, with a most complete outfit of incandescent electric lighting, consisting of a duplicate plant for 150 20-C. P. lights. Each plant consists of a Westinghouse high-speed single acting engine and a new pattern slow-speed Ferranti dynamo and exciter coupled together and mounted on one baseplate and running 600 revolutions per minute. The Westinghouse engines used have two cylinders 9 in. bore and 6 in. stroke, steam acting on one side of the piston only. All wearing parts are kept constantly in compression and knocking therefore cannot occur. The generators have been specially designed for ship lighting, the slow speed making it practicable to couple direct to the engine, all risks due to intermediate gear being dispensed with and the space required brought down to a minimum. All parts are to gauge and interchangeable, the wearing parts being arranged so that they can be replaced by any ordinary mechanic, as the electrical parts of the machine have been made permanent and free from wear. Another feature is the extreme lightness of the revolving parts of the machine. The engines are coupled to the dynamos by means of the company's new flexible couplings, thus none of the vibration on the crank shaft is communicated to the dynamo. The oiling arrangements have been very carefully worked out so as to reduce the attendance to a minimum. From one elevated oil vessel all the parts are oiled through a system of pipes, a small valve being placed at each bearing to regulate the supply to each part. After passing the valve the oil is usable as it enters the bearings. In case of heating, the valve can be fully opened and the pressure due to the elevation of oil vessel will force oil through and cool down very quickly. The wires have been specially prepared for this company to suit this class of work, and are well protected throughout from all external injury. A great source of trouble is said to have hitherto arisen in ship lighting from the lamps shaking loose in their holders through vibration of the vessel; this, however, has been overcome by the company's new holder, which is fitted to all the lamps, and is self-locking. This holder is mechanically very strong and does away with the breakage of the platinum loops of incandescent lamps. The lamps are run in parallel arc, the E.M.F. being 100 volts. The current to all parts of the vessel is controlled by the company's switches fitted to each lamp or group. The switches are very efficient and elegant in appearance, and so simple of construction as to make it almost impossible to get out of order. The special feature is, that the contact surfaces when making or breaking, wear smoothly together, keeping the surfaces bright and clean; they break simultaneously at two points, without any jerking action caused by the surfaces separating. All the parts are made by special tools, and are exact duplicates of each other. Each lamp or group is also fitted with a safety fuse to protect the wires in case of accident to any branch. The two plants are set side by side in a small recess of the engine room, measuring 12′ 6″ × 7′ 6″ × 6′, only open to the engine room, and allowing a passage round the back to get at any part of the plants. The stop valves are placed together and close to a switch-board, so that the engineer standing in one place can start and stop the engines or put either plant on to part or whole of the circuit.

Wires Across the Bridge.—The announcement that the Mackay-Bennett cable is to cross the East River on the big bridge causes increased interest in the general telegraph and telephone service performed by this structure. This bridge has proved a great boon to those immediately interested in the telegraph system between this city and Brooklyn. The casual observer passing across the bridge sees only a few telegraph wires running under his feet, whereas there are really 290 of these wires, according to the statements of the bridge authorities made to-day. The rent for these remains as at first established, namely, $30 per year for each wire. The revenue from these since the first wire was laid has been very large, the rental last year alone amounting to $8,700. There has been but little extension of the service this year. During the year two wires were taken out. The Metropolitan Telephone and Telegraph Company run by far the largest number of wires across the bridge—about two-thirds of the entire number The bridge authorities take no part in placing these wires or keeping them in repair.

The Wright Patents in the Dominion.—The Dominion Telephone Company has been organized at Montreal to manufacture and use the James Wright patents. The capital is $200,000, of which $100,000 has been taken in Montreal and vicinity. The rentals to be charged are $55 the first year, and $25 subsequently, $30 of the first year's charge purchasing the instruments, and the $25 being for maintenance. In small towns and villages the rates will be $45 first year, and $15 subsequently, with the same conditions. A new feature will be the supply of private switches for 5, 10 and 20 wires. There are at present in operation over 100 sets of instruments in the townships, and over 60 miles of line have been erected, and 100 miles are in course of construction. In Sherbrooke, Megantic, Churchville, and a number of other towns, the lines are in operation, and the company expects to commence operations in Montreal in the spring. The invention was made in March by Mr. Wright, and since then the instruments have been in use, it is stated, without interference from the Bell company. A charter was issued to the company on the 9th of August. Mr. E. P. Johnson is President, and Mr. James Wright General Manager.

Lock Wire Insulator.

We illustrate below the lock wire insulator exhibited at the Philadelphia Electrical Exhibition by Mr. Thomas McGrory, of that city. It is intended to facilitate the holding or locking of telegraph or other wires. The advantages claimed are that it holds the wire securely when once it has been passed through, so that there is neither straining nor slipping out of place; that one man can put up as many wires with this lock system as two men can

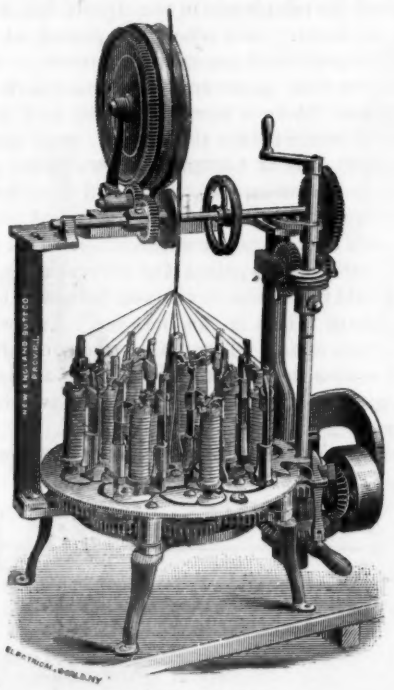


Lock Wire Insulator.

with the ordinary method of tying or wrapping; that time is saved, and that there is an economy of from 14 to 18 inches of wire on each insulator.

A New Braider.

We illustrate below a new braider made by the New England Butt Company, of Providence, R. I. and 99 Chambers street, New York. The company are manufacturers of braiding machinery for covering telegraph, telephone and electric light wire, as well as of single and double winders and braiders of all kinds for silk, worsted and cotton braid. The cut shown illustrates their No. 16 carrier large gear braider, which gives good work of very even finish, and is in every respect a first-class machine.



A New Braider.

Deprez on Electric Synchronism.

In a late number of the Society of Telegraph Engineers' *Journal* is the following abstract of a paper by M. Deprez: "The apparatus proposed by the author consists of two parts, the so-called 'annular comparative instrument' and a special form of magneto-machine. The latter has a ring of the Pacinotti type arranged between the poles of the magnet, which is free to rotate as well as the ring. Four brushes are used, arranged at right angles, and thus dividing the commutator into four quadrants; two brushes at opposite ends of the same diameter are joined up to the comparative instrument, which consists of a fixed iron ring with two windings of wire, split up in such a way that successive sections alternately form part of one or the other winding. If two electric currents of different strength are passed through this instrument, four poles will be formed on the circumference of the ring, the lines joining which will be at right angles; but the magnetic forces exerted in their direction will combine to form a resultant, the position of which will depend on the proportion of the two currents, and not on their absolute strength. A magnetic needle suspended at the centre of the apparatus will place itself along this polar line. If now this 'annular comparative instrument' be joined up to the Pacinotti ring, and the ring rotated while the magnet remains fixed, the same result will be attained as though the ring rotated inside two distinct magnetic fields. Now each pair of brushes will collect separately the current due to the magnetic influence of the perpendicular component at its line of contact, and the comparative instrument will be traversed by two currents of different strength, which will cause the magnet needle to take up a definite position. Suppose this the initial position, now rotate the magnet, leaving the brushes fixed; then to every angle described by the polar line will correspond a definite value of the ratio of the two components of the magnetic field, and therefore of the two currents produced. It may be concluded that if the brushes and the magnet are rotated at different rates, the comparative instrument, which may be placed anywhere, will show the relative displacement of the two. To adapt such an apparatus for use as a compass, the axis of the rotating ring is placed vertically, and the inducing magnet is done away with, being replaced by the natural magnetic field of the earth. The resultant of the earth's magnetic force at a point can be resolved into two components, the one being a horizontal projection of the resultant, and coinciding with the magnetic meridian—this force replaces the permanent magnet; the second is vertical to the former, and therefore without action on the ring. If, then, the brushes remain fixed, any change, however small, in the magnetic meridian will produce a corresponding change in the comparative instrument. This latter may be placed in any convenient position, while the ring may be placed at the mast-head of a ship, out of the way of all influence due to the presence of masses of iron."

Exhibits at the International Electrical Exhibition. III.

Owing to the pressure on our columns, as the result of the various important meetings held during the continuance of the Exhibition, we have been unable hitherto to give as much space as we would like to our notices of the leading exhibits. We now resume the work.

The Bowman Fire Hose Telegraph.

This is exhibited by Mr. C. M. Bowman, of the *Times*, Lebanon, Pa. The idea is ingenious, and consists in conveying electric signals along a line of hose, so that the engineer at one end of the line with his hand on the throttle, controlling the action of the engine, and the pipemen at the other end of the line, directing the stream of water at the fire, are brought into immediate communication. By its use the pipeman can command the situation. No matter where duty has taken him, he has a messenger under his thumb ready to do his bidding. He may be climbing a ladder or scaling a housetop, in which position the heavy pressure on the hose may make his footing insecure and endanger his life. In such an event he sends his electric messenger back to the engineer to relieve his burden by taking off the pressure until he has fortified himself against danger by falling, and then he signals to have the pressure put on again. It is all done in an instant. Again, the pipeman may be in a room of a building, out of sight or sound, and, having drowned out the flames, may regret the damage his deluge of useless water is doing to the building, and yet, despite his forethought, he has not the means at hand to communicate his desire to have the water stopped off, but with the Bowman Fire Hose Telegraph he turns his implement of destruction into an instrument of salvation, by simply pressing a button. The device is very simple in its details, and makes practically no addition to the weight of a line. The electric conductor is insulated wire run through the hose and properly attached at either end, without defacement to the couplings, so as to make each section complete in itself, enabling the removal of any section from a line with only temporary interruption of the circuit. The small battery and electric bell are placed permanently in any convenient part of the engine.

The Taper Sleeve Pulley Works.

These Works have a 48″ × 13″ clutch pulley on main line running 350 revolutions, which drives a 65-light Brush dynamo; and two 34″ × 8″ clutch pulleys driving two 24-light Brush dynamos. These, as we have observed personally, work in first-class manner. On a 65-light Brush machine is a taper sleeve pulley, which enables them to run with a much looser belt than if it were iron; and thus friction on bearings is minimized. They have, further, taper sleeve pulleys on all the dynamos of the Thomson-Houston Company, and one set of dead pulleys driving one of the company's large dynamos. The Western Electric Company's dynamo is driven by one of the friction pulleys made by the Works, and two of the same pulleys, 37″ × 8″, are receiving power from a Straight-Line engine driving the south line of shafting.

Okonite.

In a recent issue (Sept. 27) we gave some general facts in regard to the new insulation, okonite, shown by the New York Insulated Wire and Vulcanite Co. We learn from Mr. John A. Barrett, who was in charge of the exhibit, that considerable interest was manifested in okonite by visitors, and especially by Philadelphians, who seem determined to make their city the chosen field for underground experiments on the largest scale. In their space the company made electrical tests on one-fifth of a mile of No. 14 wire with this insulation, submerged in water. During the time, the wire gave invariably an absolute insulation resistance of 4,500 megohms, or 900 megohms per mile. The physical qualities of okonite are somewhat remarkable,

The vulcanization appears to be carried to a comparatively high degree, and a superior hardness and finish is the result. At the same time, by carefully manipulating the composition, it acquires a toughness that enables a No. 14 copper wire to be broken by torsion, leaving the covering uninjured. The forms in which okonite wires are offered to the trade comprise single wires of all descriptions, aerial, lead pipe and armored cable, adapted to any purpose.

Physiological Measurement of Electricity.

Dr. W. H. Stone, in a paper read recently in England, on the physiological bearing of electricity on health, says:

The resistance of the human body is not equal, or anything like equal or similar, to high tension and low tension currents. If this be true, and it is one of the points I hope to go some little way toward proving, all our physiological work as to currents as physiological stimulants will have to be revised in the view of this constant being altered. What is the power of these various induction machines? We know only very vaguely; it has never been measured or allowed for. The induction machines of constant current vary in their effects, not only on account of the physiological differences in the body or electrical differences in the current, but because not so much gets through in the one case as in the other. Take any case I have here in my notes. The resistance of a particular patient, suffering from diabetes, using 6 cells of my bichromate battery of about 1.8 volts each, was from foot to foot 1,210 ohms, from right hand to foot 1,350 ohms, and from left hand to foot exactly the same number. To the induction current from this little coil which I have here, which I have measured and know perfectly the electromotive force of, it was, as against 1,210, only 473 ohms. That cannot be an instrumental error. Then from the right hand to the foot, as against 1,350, it was 835. I made it 750, but I was not quite accustomed to the telephone in those days as a means of measuring two currents on a Wheatstone bridge, and I think that was an instrumental error, only amounting, however, to 15 ohms. I have since taken the resistance of a gentleman, an excellent clinical clerk of mine, a very praiseworthy student of St. Thomas' Hospital, and besides those merits he is 6 feet 3 inches high and weighs 13 stone. From foot to foot his resistance was on the mean of many experiments 930 ohms. From foot to hand, which in his case, taking the external prominence of the ulna and the external malleolus, measures exactly 7 feet, so that I had 7 feet of human conductor, the resistance in a healthy and athletic condition was only 1,027 ohms, measured many times over. With alternating currents from foot to foot, as against 930 for a mean of 3 consonant observations, it was 650; from foot to hand, against 1,027, I had the mean of 3 observations, none of which differ much, 820. I think that cannot be an instrumental error. I found a trace of this difference in another case where the electromotive force, with an ordinary battery, was gradually raised, and the same action took place, but in a very much less marked degree. It was a case of dysentery, complicated by what is called tetany, for which I gave the electricity. The man is perfectly well now, and I meet him every morning; for these experiments are not dangerous, if anything they are salutary. These are his measurements. With two little bichromate cells, 2,500, 2,600, and 2,600 ohms. With 4 cells, that is twice the electromotive force, 2,100, 2,000, and 2,000, three observations being taken at 10 minutes' interval. With 6 cells, 1,800 and 1,720. With 10 cells, 1,590, 1,450 and 1,440—this was with an ordinary battery, making an alternative current merely by means of the hand. There was always a rise or fall from polarization, which immediately takes place in the body; but, still allowing for there being a constant error in each case, the steady fall of resistance to electromotive force with these different powers of the battery quite agrees with the enormous fall which takes place when an induction coil is used. In the induction, which is an alternating current, we have the advantage of stopping polarization, but in doing so a great part of the resistance has disappeared. The body is infinitely more easily traversed, and it is to be feared physiologically that we have lost a great deal of the delicacy of the test. It seems probable that very low tension currents will detect disease earlier than these high-speed express electric currents which fly through anything, diseased and healthy tissue alike. Therefore the older method may physiologically prove the more valuable, though here I wish to speak at present with some reserve.

Another point may be named here. I can show that the resistance of the body is much altered in disease, and that it also alters with the metallic impregnation which takes place in certain trades. I have substantiated this with regard to copper, in a copper worker, and found a difference of nearly 300 ohms between the hand with which he held the hammer, which was impregnated with copper, and the other side. I afterwards extracted from his secretion 3 milligrammes of metallic copper. With mercury the resistance goes down very distinctly, and with lead to a less extent, and I am now investigating silver. Silver I can obtain electrolytically from the body; as to its exact diminution of resistance I wish also to speak with reserve.

THE TELEGRAPH.

Women Telegraphists in England.—In London the question what to do with the boys shrinks into insignificance when contrasted with the corresponding question of what is to be done with the girls. The fact that on Sept. 26 more than 1,400 girls, between fourteen and eighteen years of age, underwent the ordeal of a competitive examination in arithmetic, handwriting and dictation to fill about twenty vacancies as telegraph learners that may occur in the Post-Office during the next six months, is a proof of the overstocked condition of the labor market for women. Last June, it is stated, more than 500 girls, of ages ranging from eighteen to twenty, competed for a similar number of vacancies as female clerks, so that all the departments of the Post-Office in which women are employed are besieged by an army of applicants.

Development in Canada.—A Montreal newspaper correspondent says: There has been a great development here of late in the receipts of the Great Northwestern Telegraph Company. Your correspondent is assured that the number of dispatches sent out daily from the head of the Eastern division in this city has increased to a wonderful extent, being higher of late than has ever been known in the history of the present company or its predecessor, the Montreal Telegraph Company. The average number of messages daily dispatched of late from here has been fifteen hundred, some days largely exceeding this maximum, whilst last year the average did not reach eleven hundred. At the same time, the year preceding two years ago, the number of messages averaged over two hundred and fifty less than at present. The ratio of increase in cable messages has not been so great as the inland, but it has also marvelously grown, and like the inland business is rapidly increasing from day to day. It is a fact, I am assured further, that notwithstanding this immense development, which must be created by more trade occurring, the Telegraph Company has not had to augment its expenses in any way since it made a great reduction in its clerical and operative staff as well as in their wages a year ago. The fact is that the extra work has been done by the existing staff, which is now, it is said, grumbling at having far more to do than formerly and far less remuneration. It is stated that there are mutterings of discontent cropping up among the employés, who think that when they are so overwhelmed with extra work they should get a rise in their salaries. Those operators who are not engaged by the month rather enjoy the extra employment, for they are making higher wages. The manifest prosperity of the business, however, does not seem to have had any beneficial effect on telegraph shares sold on the Exchange, as both Montreal and Dominion have been steadily declining of late, as well as all other securities. As an evidence that the trade of the country is not so stagnant as some parties represent it, there can be no better proof than the telegraph features herein described.

THE TELEPHONE.

Telephones for the Tropics.—The Tropical American Telephone Company, of Boston, Mass., make an important announcement in our advertising columns to-day respecting the sale of telephones in their territory. By *exclusive contract* with the American Bell Company, the Tropical Company have the *sole right* to export their patented telephones and telephonic apparatus from this country to South America, Central America and the West Indies. Parties buying of them are free from liability of suit for infringement of U. S. patents, to say nothing of getting genuine goods acknowledged to be the best in the world.

Extension in New Brunswick, Can.—For many years the necessity of telegraphic communication between St. John and St. Martins has been felt, says the St. John *Telegraph*, of Oct. 9, and its absence deplored by those having business relations with that thriving place. The negotiations, at times, have almost carried, and then dropped off. What will supply the deficiency is now about to be provided. A meeting in the interest of telephone communication between St. Martins and St. John was held at the office of the Telephone Co. yesterday afternoon. St. Martins was represented by Messrs. W. E. Skillen, W. H Rourke and James Rourke; Black River by Mr. John McLeod; Salmon River by Mr. W. J. Davidson; Henry Lake by Mr. A. Shirley Benn, besides which there was a large attendance of St. John gentlemen interested in the scheme. Mr. W. J. Davidson took the chair. It was decided to build a line from St. John to St. Martins (via Black River road, connecting with Black River, Gardiner's Creek and Tynemouth). The distance is 35 miles, with a branch to Salmon River 12 miles, and one to Henry Lake of 6 miles. Mr. J. H. Wagstaff, District Superintendent, was authorized to advertise for tenders for poles and their erection. The stock is $2,000 in 200 shares of $10 each, and most of it was subscribed on the spot. A call of 50 per cent. was ordered, 25 per cent. to be paid at once and the other 25 per cent. on Nov. 1. Mr. R. O. Stockton was authorized to draw up a bill of incorporation for the company, to be submitted at the next meeting for its approval. Work will be commenced forthwith and it is expected that the line will be in operation in about six weeks.

THE ELECTRIC LIGHT.

A Luring Light.—On examination of the Capitol at Washington, where the electric light has been used, it has been found that the building presents a most untidy appearance by reason of the billions of insects which have been drawn thither by the brilliancy of the electric lights, and whose skeletons are either hanging on the walls, held fast by a death grip, or are piled up in heaps all over the recesses of the roof. To the student of insect life this would prove a grand field for study and discovery. There are myriads of May flies, beetles, crickets, earwigs, dragon flies, grasshoppers, caddis flies, bees, wasps, ants, hornets, butterflies, moths, cicadas, froghoppers, plant lice, water beetles, whirligigs, skippers, horned midgets, gnats, mosquitoes, and every species of insectoria known to the surrounding swamps and woods of the district.

MISCELLANEOUS NOTES.

Brooklyn Bridge.—There is still great dissatisfaction with the cable railroad on the bridge, and the Knight-Bentley Company have submitted to the trustees a proposal to work the road by electricity, on the plan recently demonstrated with success at Cleveland, O.

Printing a Paper by Electricity.—As indicative of the enterprise and success of The Electrical World, I may mention, says the Philadelphia correspondent of the London *Telegraphic*, that during the current month that paper will be printed by electricity. In a conversation with Mr. Stump, the business manager for Mr. Johnson, I learned that this innovation entailed very heavy expense; but, judging by the number of papers sold, it is not likely to be an unprofitable undertaking. Great crowds surround the machinery as it rolls out each sheet, and the curiosity-seekers are eager to obtain one for 10 cents. A small "Daft" motor is employed to run the machinery, and it is somewhat surprising to see what power is obtained from it.

Electric Railways Abroad.—The cities of Frankfort and Offenbach are now connected by an electric railway, 6,665 metres (about 4⅛ miles) long, of 39 inches gauge. It leads from Frankfort through Sachsenhausen, Oberrad, and through the entire town of Offenbach. The trains run over the entire route in about twenty-five minutes. Austria is going into electric railways on a liberal scale, an extensive system of communication being planned, the cost of which is 7,000,000 florins. The house of Siemens & Halske, which has done so much for the development of the industrial uses of electricity, is to construct the projected system, which is expected to revolutionize street travel in the chief Austrian cities.

Death of Dr. Schellen.—We regret to announce the death of Dr. Heinrich Schellen, formerly director of the Cologne Realschule, and author of two well-known works, "Der electromagnetische Telegraph" and "Die Spektralanalyse." Besides these, Dr. Schellen published a book on arithmetic, an excellent German version of Padre Secchi's great work on the sun, and various other works on physical subjects. It was under his directorship and by his efforts that the Cologne School was raised from the rank of "Burgerschule" to that of "Realschule erster ordnung," and that it attained the high reputation it now enjoys. He died in Cologne in the first week of September, aged 66 years. His well-known work on "Magneto-Electric and Dynamo-Electric Machines," translated and enlarged by Mr. N. S. Keith, the editor of the scientific department of The Electrical World, has just been issued by D. Van Nostrand.

A Five Years' Campaign.—"The great secret of doing away with the intermediary furnaces, boilers, steam engines and dynamos, will be found, probably," says Mr. Edison, "within ten years. I have been working away at it for some months and have got to the point where an apparently insurmountable obstacle confronts me. Working at the problem now seems to me very much like driving a ship straight for the face of a precipice and when you come to grief picking yourself up and trying it again to-morrow. There is an opening in the barrier somewhere and some lucky man will find it. I have got far enough to know that the thing is possible. I can get quite a current now directly from the combustion of fuel. Jablochkoff tried his hand at the same thing some years ago, and so did some Germans, but the results were laboratory curiosities only. I give myself five years to work at it and shall think myself lucky if I succeed in that time. The unscientific world has no conception of what such a discovery would mean. It would put an end to boilers and steam engines; it would make power about one-tenth as cheap as it is now; it would enable a steamship to cross the Atlantic at a nominal cost; it would enable every poor man to run his own carriage; it would revolutionize the industrial world."

STOCK QUOTATIONS.

Telegraph, telephone and electric light quotations on the New York Stock Exchange, Boston Exchange, and elsewhere are as follows:

Telegraph.—Am. Cable, b. 55, a 56½; B. & M., a 10; Mutual Union, b 14¼; Postal stock, b 2⅝, a 3¼; Postal sixes, b 26, a 30; Western Union, b 64⅜, a 64⅝.

The directors of the Western Union Telegraph Company this week issued an appendix to the annual report, giving the report of the committee which was recently authorized to examine the assets in the treasury. The list of securities now in the possession of the company differs but little from the list published a year ago. Their aggregate par value foots up a little more than $14,500,000. The principal holdings of the Western Union are as follows: Twenty-three thousand eight hundred and sixteen shares of California State Telegraph Company stock, par value, $2,381,000; 19,438 shares Gold and Stock Telegraph Company stock, par value, $1,943,800; 16,231 shares International Ocean Telegraph stock, par value, $1,623,100; 58,300 shares Pacific and Atlantic Telegraph stock, valued at $1,457,500; 12,075 shares Bell Telephone Company, of Canada, $1,207,500, and 6,290 shares Franklin Telegraph Company, valued at $629,000. The Western Union Company also holds $65,300 of the bonds of the Gold and Stock Telegraph Company and 1,500 United States 4 per cents.

Telephone.—American Bell, b 177, a 179; Erie, b 18; Mexican, a 1¾; New England, b 27¾, a 28; Tropical, b 1¼.

Electric Light.—No sales.

BUSINESS NOTICES.

A Pocket Hand-Book.—The Washburn & Moen Mfg. Co., New York and Worcester, Mass., have issued the fifth edition of their little hand-book, on iron and copper wire used in electric transmission, and giving the "world's facts of electric service." We can only say that we have never seen more valuable information in so small a compass. The tables of figures and comparisons of weights and measures are extremely useful. The historical portion is also interesting.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

Edited by N. S. KEITH, Electrical Engineer and Expert, 9 Murray Street, New York.

PATENTS DATED SEPT. 30, 1884.

Apparatus for Communicating Telephonically; W. N. Marcus, Philadelphia, Pa..... 305,829

Consists in the combination and arrangement of a speaking-tube and a circuit-wire with a telephone receiver for transmitting and receiving articulated speech through a telephone located in a distant room from the operator.

Art of Biplex Telegraphic Transmission; B. E. J. Eils, Washington, D. C..... 305,908

Consists of an improvement of the art of simultaneously transmitting two distinct telegraphic messages in the same direction over a single line wire, according to which improvement such of the respective signals or portions of signals of the two messages as do not happen to be made simultaneously, or, in other words, are non-concurrent, are transmitted by currents the same in polarity but different in tension, while the concurrent signals or portions of signals of the two messages are transmitted by a reverse current.

Combined Gas and Electric Light Fixture; S. B. H. Vance, New York City..... 305,984

The aim is to render the connection of the fixture with gas-pipe and conductors simple, neat and reliable, to provide distinct ducts in the fixture for gas and wires, and to fully conceal and protect the passage of the wires into the fixture, and to render the exterior of the fixture neat and finished in appearance.

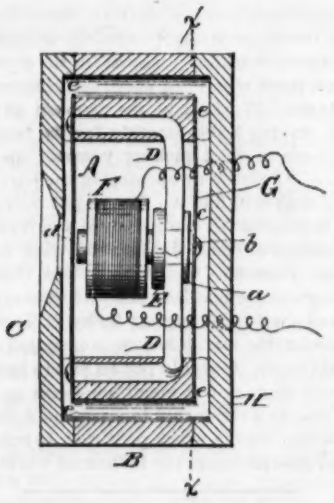
Conduit for Underground Conductors; Daniel H. Dorsett, Chicago, Ill..... 305,904

A suitable plastic material is made into sections containing one or more ducts, and provided at their ends with metallic ferrules or cylinders, forming parts of a coupling device, which ferrules or cylinders are placed in the mold and united to the sections by the plastic material, which, entering slots, grooves, or the like formed in them while soft, unites them firmly and securely when it hardens.

Telephone Receiver; G. M. Hopkins, Brooklyn, N. Y..... 305,927

The diaphragm *A* is clamped on the cell *B* by the apertured cap *C*. Three or more permanent bar-magnets, *D*, bent at right angles and then curved spirally, are secured by their straight ends to the diaphragm *A* near its periphery, and their curved ends converge toward the centre of the cell *B*, and are clamped by the washer *a* and screw *b* to the enlarged inner end of the pole-piece *E* supporting the said pole-piece axially to the cell, and with the smaller end near but not touching the centre of the diaphragm. Upon the pole-piece *E* is mounted a helix, *F*, whose terminals are connected with the wires of the telephone circuit.

Upon the back of the cell *B*, opposite the diaphragm *A*, and parallel with it, is secured an auxiliary diaphragm, *G*, by means of the cap *H*, and the centre of the said diaphragm is secured to



the washer *a* and pole-piece *E* by the same screw, *b*, that binds the curved ends of the bar-magnets to the pole-piece. The diaphragm *G* partakes of the vibrations of the magnets and pole-piece, and it need not consist of magnetic material. The cap *H* has a chamber, *c*, which communicates with the space *d* between the diaphragm *A* and cap *C*, through the passages *e*, formed in the caps and in the body of the cell. When changes occur in the current traversing the helix *F*, the changes effected thereby in the magnetism of the core *E* cause the alternate attraction and release of the diaphragm *A*, and a reciprocal attraction of the core, and a corresponding, although diminished, motion of the parts attached to the core, including the diaphragm *G*. The sounds produced by the diaphragm *G* are communicated to the ear through the chamber *c*, passages *e*, and space *d*, and serve to re-enforce the sound proceeding from the diaphragm *A*.

Device for Stringing Wires; S. McAuliffe, of Rochester, N. Y..... 305,946

Consists in an automatic carrier, to which the broken wire is attached, the carrier running on one of the uninjured wires and propelled by spring power.

Electric Alarm Signal; I. H. Farnam, Portland, Me..... 305,747

Consists in applying to the machine a clock-work attachment which constantly tends to change the normal condition of an electric circuit, and which is adapted, if said tendency remains unchecked for a definite period of time, to accomplish the said change and actuate an alarm, but which, so long as the machinery is performing its due functions correctly, is constantly checked at a point short of the point of change, the alarm consequently not being given.

Electric Cable; T. G. Turner, New York City..... 306,037

Consists in novel parts and combinations whereby the armor may be opened at any point to gain access to any of the wires and be again closed without damage to the wires.

Electric Cable; W. A. Shaw, Pittsburgh, Pa..... 305,854

A combination of two or more groups of wires, each group consisting of two or more insulated wires inclosed within a leaden sheath, and a metallic protecting pipe or covering inclosing the groups.

Electric Lamp; T. L. Dennis, of Newburyport, Mass. 306,005

Divides the wire of the magnet into two or more sections, with a connection between them, controlled by a lever or key contact controlled in turn by the magnet itself, so that the amount of wire of the coil or resistance in the magnet-circuit is automatically adjusted to meet the requirements of the lamp.

Electrolytic Liquid for Secondary Batteries; W. E. Case, Auburn, N. Y..... 305,737

An electrolytic liquid containing zinc sulphate and magnesium oxide.

Electro-Therapeutic Apparatus; C. L. Clarke, Manchester, England..... 305,894

Details of combinations constituting such an apparatus.

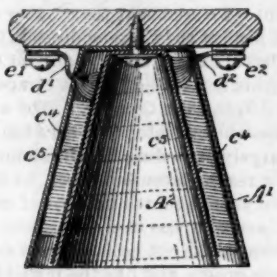
Incandescent Electric Lamp; G. W. Hickman, of Washington, D. C., and J. F. McCoy, of Rahway, N. J..... 305,817

A method whereby copper leading-in wires may be used in place of those of platinum.

Telephone Receiver; T. F. Taylor, of Brooklyn, N. Y..... 305,980

A' represents a conical or cylindrical metallic box, preferably

Fig. 1.

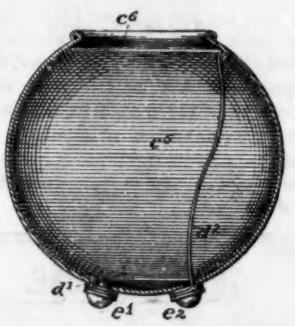


formed of sheet-iron, and at A^2 is shown another similar cone or box, which is smaller than and placed inside of the cone *A'*, so that the axes of both are coincident.

The conductors c^4 upon the cone *A'* are preferably wound upon the exterior of the same, and the conductors c^5 on the cone A^2 upon the interior surface thereof. The respective terminals of the series are connected with the incoming and with the outgoing main line by being united at the incoming and outgoing binding-posts e' and e^2.

In Fig. 2 the series of electric conductors c^5 are supported in a

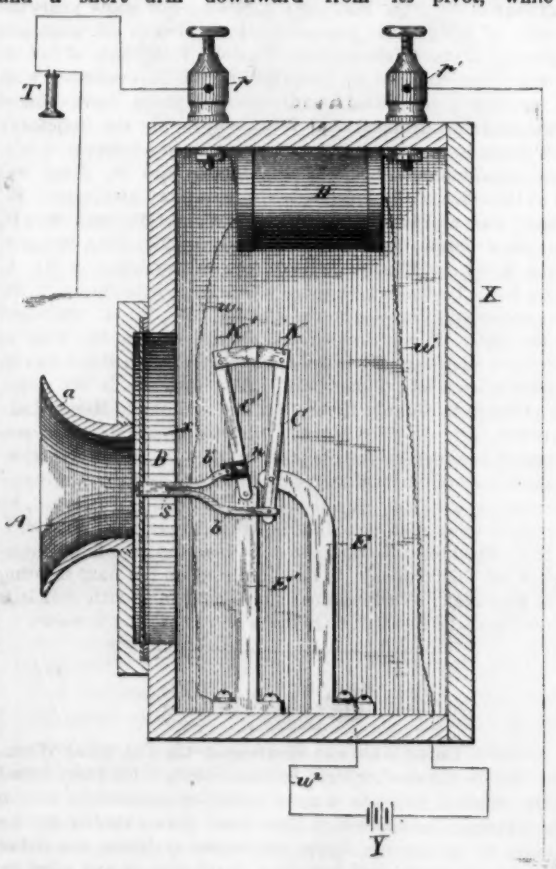
Fig. 2.



spherical form by being secured to the interior of a sphere, c^6. The conductors c^5 are connected in multiple arc in this organization in precisely the same manner as in that already described.

Electric Telephonic Transmitter; W. B. Hale, of Washington, D. C..... 305,812

The letter *X* indicates the inclosing-casing, having in its front wall a circular aperture, *x*, in front of which a diaphragm, *A*, and mouth-piece *a* are secured in the usual manner. Within and upon the bottom or floor of the casing stand two metallic standards, *E* and *E'*, the former having its upper end curved slightly toward the diaphragm. To the top of this standard is pivoted a lever, *C*, having a long arm extending upward and a short arm downward from its pivot, while to



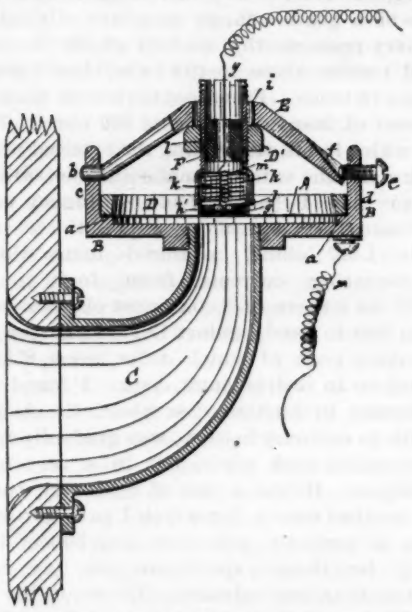
the top of the standard *E* is pivoted the lower extremity of an upwardly-projecting lever, *C*. These levers have fastened to their tops, respectively, the electrodes *K* and *K'*, which have their facing surfaces beveled wedge-like and in lapping contact with each other. These electrodes are preferably made of carbon, such as is used for battery plates and other electrical purposes, and are held in yielding contact with each other by the elasticity of the metallic levers *C C'* when they are lapped and the levers upright, as shown. These levers are held upright by being pivotally connected with the prongs *b* and *b'*, respectively, of a forked arm *B*, projecting from and secured to the centre of the diaphragm *A*. The prong *b* is the longer of the two, and is pivoted to the lower end of the short arm of lever *C*, while the prong *b'* is pivoted to a non-conducting lug *n*, rigidly fastened to the lever *C'* between its pivot and its upper or electrode-bearing end. The arm *B* is split horizontally for a portion of its length from its forked end, as shown at *s*, in order that the forks *b* and *b'* may be sprung slightly away from each other under strain and resume their normal positions when the strain is removed. Power for moving the levers *C* and *C'* is applied through the prongs *b* and *b'* and, as the levers are connected or linked together by the prongs and arm *B*, they must move simultaneously. The lever *C* is of the first class, and the lever *C'* of the third class, and when the arm *B* is moved in the direction of the arrow, the prongs will swing the levers *C* and *C'*, so that their electrodes at their upper ends will be pressed toward each other endwise, and their wedge-like shape causes an increase of pressure between them as they are thus moved, as well as an increase of their lapping surfaces. When the arm *B* moves in the opposite direction, a reverse movement of the electrodes takes place with a corresponding decrease in their pressure and lapping surfaces.

Local Circuit for Telegraphs; B. E. J. Eils, Washington, D. C..... 305,906

Consists, primarily, of a normally-open main local circuit provided with a branch circuit, which is automatically closed by the sounder on the closing of the main local circuit by the armature-lever of the relay, and by which the magnetization of the sounder-magnet is maintained after the opening of the main circuit by the relay. There is provided, in addition, a second branch circuit, which is closed, at the end of each signal, through the back contact of the relay, to neutralize the current in the first branch circuit, but is immediately opened again by the armature-lever of the sounder.

Telephone Transmitter; C. W. Long, of Louisville, Ky..... 306,026

B is the case of the transmitter, and *C* the voice-opening. The diaphragm rests on an annular shoulder, *a*, in the case, and is held down by a clamping-ring, *D*, provided with a central bow, *D'*. The ring is held down with clamping pressure on the diaphragm by a bridge-piece, *E*, which spans the case *B* at right angles to the bow *D'*, and rests on the central part of the latter. One end, *b*, of the bridge-piece enters a hole in an ear *c* on one side of the transmitter. On the opposite side of the transmitter is another ear, *d*, through which passes a clamping-screw *e*, whose inner end bears upon the inclined upper face of the other end *f* of the bridge-piece. By advancing the clamping screw it



will act to force down the bridge-piece upon the bow D', and thus to clamp the ring *D* upon the diaphragm. The contact-button *g*—usually of carbon—is surrounded by a ring, *h'*, of non-conducting material, attached to the diaphragm, and is held against the button by a spring, *h*, whose pressure is regulated by a screw-thimble, *F*, which passes through an opening, *i*, in the bridge-piece *E*, and screws into and through a hole in the bow *D'*, which thus forms a bearing for the thimble. The thimble at its inner and lower end is enlarged, so as to encircle and inclose the spring *h*. The latter is confined between a shoulder on the thimble above and the button *g* below, a disk, *j*, of non-conducting material, being interposed between the spring and the button. To the button is electrically connected the conducting-wire *y*, which for a portion of its length is coiled, as shown at *k*, this coiled portion being usually made of thin platina wire. The wire passes out from the transmitter through a tubular non-conducting plug *l* inserted in the thimble *F*.

Mechanism for Driving Dynamo-Electric Machines; J. R. Markle, Detroit, Mich..... 305,943

A friction wheel on the armature shaft is brought into engagement with its friction driver by moving the armature shaft longitudinally.

Quadruplex Telegraph; B. E. J. Eils, Washington, D. C..... 305,909

A combination, at one station, of two keys or transmitters, two batteries, or two sections of a battery, and connections, whereby the transmitters, when working separately, send to line currents the same in polarity but different in tension, while both transmitters, when working simultaneously send a reverse current to line.

Quadruplex Telegraph; B. E. J. Eils, of Washington, D. C..... 305,907

My improvement consists in employing as part of the second local branch used for discharging the sounder-magnet at the termination of each signal, as described in my aforesaid application, the front contact-screw and armature-lever of a subsidiary neutral relay in the line-circuit, the said armature-lever of which is held against the said front contact-screw under all line-currents, but is momentarily retracted during reversals of the line-current, so as to break said branch during the period of demagnetization of the neutral receiving-relay, and thus prevent the discharge of the sounder electro-magnet at times when a reversal occurs while the sounder is making a signal.

Telephone Receiver; G. M. Hopkins, Brooklyn, N. Y..... 305,928

Consists of a sectional bar electro-magnet, each section of which is provided with a coil, and separated from the adjacent section by a yielding medium, two diaphragms of non-magnetic material pressed one upon each end of the said bar-magnet, and a sound-conduit, for conveying to the ear the sounds emitted by the diaphragm remote from the ear.